# SPECIAL SERVICE FEATURE ISSUE

# RADIO & TELEVISION NEWS

1954 35 CENTS In Canada 40

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NEW TV BESIGNS FOR 1954

FUNDAMENTALS OF COLOR TY

SERVICING TAPE SECONSERS

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"SELF-COMPLETING"
ELECTRONIC KEY

"DIFFUSICONE-D" ENCLOSURE

E-Y MODEL 888 MICROPHONE

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# time and money saving new RAYTHEON BROW-LITE

Here's another sensational Raytheon first. It's a different kind of flashlight that sheds a new light on Radio-TV servicing - makes it faster, easier, more profitable.



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- REPLACES FLASHLIGHTS easier, safer to use
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YOU BUILD this Wavemeter and use it to determine frequency on transmitter currents.

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growing? Have you considered what this amazing progress can mean to you?

Even without Television the industry is bigger than ever before. Over 115 million home and auto radios, 3000 radio stations, about 200 TV stations with Eundreds more being built. Expanding use of Aviation and Police Radio, Micro-Wave Relay, Two-Way Radio for buses, taxis, etc. makes opportunities for Communications Technicians and FCC licensed operators. New jobs, more jobs for beginner! Better jobs, better pay for experienced men!

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Operator
TV Technician
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Operator

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COVER PHOTO: Mary Hartline, lovely queen of ABC's "Super Circus" as she would look on color television. The microphone visible at the top right is an Electro-Voice Model 666. For details on this unit, see page 63. (Ektachrome by Mickey Pallas)

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TELEVISION NEWS

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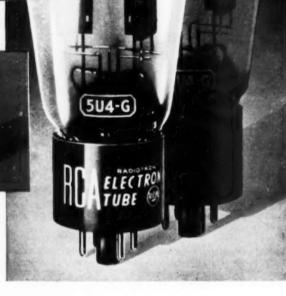
DEFOREST'S TRAINING, INC.

MARCH, 1954

# They look alike...

... but what a difference!





# These RCA types today give you...

RCA receiving tubes provide the superior performance and reliability usually associated with higher priced specialty designed types. That's because RCA receiving tubes are constantly being improved to meet the changing requirements of radio and television applications.

For instance, the RCA-5U4-G features a new electrolytic coating on its channel filament which produces a uniform, hard emitter, leading to greatly increased life over the older version.

Or take the RCA-6W4-GT. This type now uses a new RCA-developed carbonized plate-coating material which has improved heat-dissipating properties, thus contributing to longer tube life and increased reliability.

The RCA-6AL5 now utilizes double helical heaters to insure low hum and pinched cathodes to minimize cathode shift within the mount. These features make possible greatly reduced microphonics.

The superior performance of regular RCA receiving tubes-at regular prices-eliminates unnecessary call-backs, assures you of greater customer satisfaction, results in increased profits for you.

When you sell a receiving tube, your reputation and profit depend on its performance and reliability.

So, you just can't afford to buy anything less than the best in receiving tubes . . . and that's RCA.

Longer Life

Superior Performance

At No Extra Cost



RADIO CORPORATION of AMERICA ELECTRON TUBES

HARRISON. N. J.

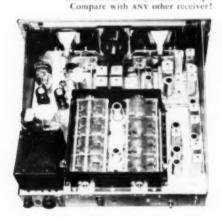
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- 7. Antenna trimmer.

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band spread tuning.

- 8. Amplified and delayed A. V. C.
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- 10. Second conversion oscillators crystal controlled.
- 11. Inertia tuning (fly wheels both dials),
- 12. Full frequency coverage from 535 kc. to 33 mc.
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- 14. Logging scales on each tuning shaft.
- 15. Dial locks on each tuning shaft.
- 16. Tuning dial indicators resetable from front panel for maximum calibration
- 17. Auxiliary A.C. socket on rear of chas-
- 18. Illuminated band-in-use indicator,
- 19. Illuminated S meter.
- 20. Dual S meter calibration S units and microvolts.
- 21. Auxiliary power socket plus .6 amps at 6.3 volts and 10 ma at 150 volts for accessories.
- 22. Standard 834" by 19" panel for rack mounting if desired.
- 23. 50 kc i.f. output jack via cathode follower for teletype converter, etc.
- 24. Five position response control (tone control).
- 25. Two r.f. stages (Bands II to VI).
- 26. 17 tubes plus voltage regulator, ballast tube and rectifier.
- 27. Automatic noise limiter circuit.
- 28. Phono Jack.
- 29. Audio output transformer for 3.2, 8, 500/600 ohm loads.
- 30. Fuse for overload protection.
- 31. Auxiliary sensitivity control permits monitoring of local transmissions in standby position.



## Makes it Easy to Enjoy the Hi-Fi System You Want

Specifically designed by E-V to house any of the popular tuners, amplifiers and record changers. Makes it easy for anyone to install with ordinary tools all the components needed for true High Fidelity sound. Available in lustrous Tropical Mahogany or sparkling Blonde Korina. Size: 29¾" high, 20½" wide, 18¾", deep.

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Note how the PEERAGE complements an E.V folded-horn speaker enclosure. The simple, graceful lines harmonize with all E.V enclosures and blend with any contemporary setting.



# For the RECORD.

# TALKIES, TELEVISION, AND TAPE

THE history of our industry will some day record the year 1954 as one of the most competitive periods of tremendous technical achievements in the field of electronics. The past year concluded with many developments still in the experimental stage. One, wellknown to millions of moviegoers, was the mad race to win public acceptance of a particular 3-D system. All in all, we've witnessed many showings on all shapes and sizes of screens and have listened intently to an even greater number of sound systems. Some of these have provided a spatial effectdepending on the individual seating location. Others have simulated, to some degree, a stereophonic effect by employing multitrack audio channels into widely separated loudspeakers.

We've drawn some conclusions and perhaps the most definite is that stereosound techniques have reached only the half-way mark on the road to binaural reproduction or its effect.

The peculiar and unfortunate technical requirements for true 3-D motion pictures with binaural sound are well-known to the physicist and the audio engineer. But the public simply will not accept the fact that it must be encased in a network of earphones and polaroid glasses to watch 3-D and listen to binaural sound for any length of time, with the attendant discomfort and fatigue that results.

The public has accepted the new screen techniques as providing realism and perspective for the picture. Audio systems used with Cinemascope and Cinerama have done wonders to educate the public to the need for better sound. These recordings have about twice the frequency response of conventional theater sound and a wider dynamic range of musical scores greatly enhances the action. We feel that the public will support any screen technique that provides the ingredients of high-fidelity sound and wide-screen optical effects. Of the two-audio needs the most attention. It will be interesting to see which system wins greatest public favor. The small movie houses simply do not lend themselves, acoustically, to the requirements of wide range audio at high volume levels. This is just one of many obstacles that must be met in the ensuing year.

And, this is the year when color tele-

vision emerges from the laboratory as a full-fledged giant in our industry. Hand-in-hand with live telecasts in color will be rapid development of electronic photography. Certainly one cannot overlook the tremendous contributions of Crosby Enterprises and RCA engineers in making such rapid progress in video recording on magnetic tape. Those of us who witnessed the first RCA demonstration of "recorded color TV" will, in years to come, remember the occasion as representing a new era of photography for industry, the theater, and the home.

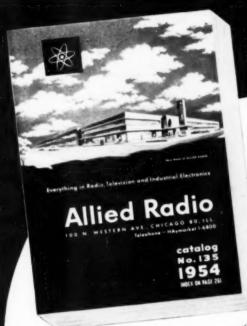
We've been in on many "firsts" in reporting technical achievements of our electronics industry. But, we don't recall any "preview" that represented a development that was so highly refined and one that was capable of rousing such great enthusiasm as the one at Princeton. There's little doubt that our future home movies will be photographed on magnetic tape and that the visual and audio information will be "played back" through our television sets for the entire family to see and hear.

Another important use for magnetic tape is the control device developed by *G-E*'s engineers. This machine is a tape record-playback device that directs a machine operation on a process cycle from information recorded on the magnetic tape. A machinist, skilled in an operation, performs the functions of operation on the original piece of work.

Each motion of this correctly executed operation is recorded on the tape as a result of translation to electrical signals via selsyns. Playback of the tape then duplicates the operation of the machine and an identical part is thus produced. The tape can be stored until needed to re-fill an order. In its present stage of development any control or motion that can be operated from electrical signals can be done with this tape playback control device.

There is an almost unlimited horizon for applications of magnetic tape in fields of sound and signals. Any device that can be controlled by electrical signals in conjunction with selsyn motors can be controlled *via* signals recorded on magnetic tape.

The year 1954 certainly will see rapid progress made in each of the three T's—talkies, television, and tape, O.R.



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Quality is an elusive thing. Engineers measure it...copywriters glorify it... salesmen describe it. But the final test is actual performance. If a product is the best in its field, those who know quality will accept no other.

That is the story of Pickering's new 260 Turnover Cartridge.

Introduced only months ago, it is already a leader among magnetic cartridges. It has won that position because it is the nearest thing to perfection yet produced. Here are the combined advantages it offers:



The nearest Thing to Perfection

- 1. HIGHER OUTPUT—Better overall signal-to-noise ratio.
- 2. LOWER OVERALL DISTORTION

  —Less intermodulation distortion with

  wider frequency response.
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  -Lowest practical tracking force for
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- 4. HIGHER COMPLIANCE Compliance of moving elements is the highest practical, consistent with best-quality transcription arms and changers.
- 5. LOWER MOVING MASS

   Lowest of any comparable magnetic cartridge.
- 6. TWO DIAMOND STYLI-For longer record and stylus life and greatest economy.

These design features have real meaning to those who understand that quality reproduction depends on components which meet professional standards. If you want the best that high fidelity can offer, ask your dealer to demonstrate the new 260 Turnover Cartridge. You, too, will hear the difference!



PICKERING and company incorporated . Oceanside, L. I., New York

PICKERING PROFESSIONAL AUDIO COMPONENTS

"For those who can hear the difference"

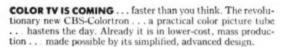
# New CBS Color tron

**NOW IN MASS** PRODUCTION



Unique photographic process, like photoengraving, uses aperture masks as negatives to print consecutively the red, green, and blue phosphor dats (250,000 of each) on CBS-Colortron screens.

After tri-color screens are printed, aperture masks are temporarily removed and face plates move on to critical inspection for screen imperfecfigne.



As in black-and-white tubes, the CBS-Colortron's screen is deposited directly onto the inside of its face plate. A unique photographic technique makes this possible. Because each aperture mask serves as a negative to print its tri-color screen, perfect register of mask and screen is automatically achieved and maintained. The rugged, simple, light-weight mask sharply reduces assembly and exhaust problems. And the spherical design of mask and screen simplifies convergence circuitry and adjustment.

The CBS-Colortron is now a 15-inch, round tube. But, as soon as tooling is completed, it will be made in larger sizes. Watch for the new CBS-Colortrons. You'll see plenty of them soon. And you'll be sold on sight by their logical simplicity . . . their superior performance . . . their many advantages.

# CBS-Colortron offers many advantages



tri-color electron gun) shows sim-



Cross-section (face plate, aperture mask, Spherical screen and aperture mask of CBS-Colortron simplify convergence and focus. plicity of CBS-Colortron and its adaptability Electron beams remain in focus over entire



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MARCH, 1954

11

# G-E TUBES ARE SERVICE-TESTED

IN INDIANAPOLIS: Howard W. Sams & Co., Inc. regularly checks the performance of current-production G-E tubes in all popular TV chassis, at various line voltages.



A Howard Sams staff member tests General Electric tubes in one of a series of TV chassis of different makes. The preheating panel at right makes it possible to have up to 30 tubes ready at one time for substitution and test.



# Simplify your tube requirements, reduce service call-backs, with G-E interchangeable tubes!

SINCE September, 1953, the nationally-known Howard Sams TV-radio technical organization has checked G-E receiving tubes for servicing interchangeability.

A number of tubes of each type are selected periodically for test. The tubes are fully representative of normal production—their performance ranges all the way between top and bottom limits of the permissible variation in tube characteristics. The tubes are all tested

at various line voltages in TV chassis of different makes. Their performance is accurately checked by instruments. When a tube fails to operate satisfactorily in any chassis, that fact is noted in the detailed report sent by Howard Sams to General Electric.

Based on these reports, G.E. as described at right—takes prompt corrective steps that help give you tubes you can install successfully in every make receiver!

# FOR TV-SET INTERCHANGEABILITY!

AT GENERAL ELECTRIC: the Howard Sams reports are carefully studied for ways in which G-E tubes may be improved for wider usefulness in servicing.



A General Electric tube engineer—with a Howard Sams analysis before him—re-checks tube performance in the same make of chassis where difficulties were reported.



A General Electric executive micro-inspects a tube structure, to determine whether or not manufacturing or test requirements need to be changed.

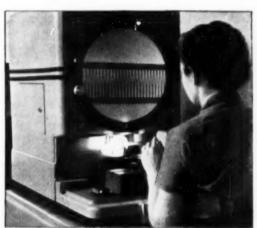
# Ever-better quality is the aim of G-E tube manufacture and testing!

So that G-E tubes will give superior service in all receivers, G.E. exhaustively studies each case of unsatisfactory performance reported by Howard Sams.

First, a cross-section of General Electric tubes of that type is tested in the same make TV chassis where trouble was encountered. Afterwards, tubes other than G-E are substituted and checked.

By comparison and analysis, any G-E tube performance fault is established and isolated. The cause then is determined by laboratory investigation, and corrective steps follow immediately. These may take the form of an improvement in manufacture or inspection, or revised tube test specifications.

Result: you are always installing better G-E tubes. Your General Electric tube distributor is your source for a product that is constantly being improved in quality and interchangeability. General Electric Co., Tube Department, Schenectady 5, New York.

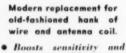


A General Electric plant employee checks a tube grid, using a comparator that greatly magnifies the companent which is to receive special attention.

GENERAL ELECTRIC



Vari-Tenna



- gain up to 25 times.
- Pulls in hard-to-get-stations.

50,000,000 old and inexpensive radio sets now in use NEED a VARI-TENNA . . . including many of your own customers' Superex Vari-Tenna gives all the power and reception of modern sets . . . lets you hear stations never before available.



# Ferri-Loopstick

List \$150

Even brand new radios, still equipped with old-fashioned loop antennas, can benefit from this "hot" loopstick. Adds 20% gain to even the powerful Ferri-Loopstick. Q up to 350, will outperform any coil with a core 3 times its length. 1-hole snap in mount; self-locking vinyl adjustment collar.

# Popular enough to be imitated

Recommend these compact. highly sensitive money makers.

FERRI-LOOPSTICK

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Pulls in stations strong and clear. Customers rave over performance. | crometer adjustment.

VARI-LOOPSTICK List \$1.00

Same as Ferri-Loopstick with variable mi-

BE SMARY! Boost your reputation as a technician make handsome profits. Recommend Superex products to your customers on every call.





\* Presenting latest information on the Radio Industry.

# By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

COMPATIBLE COLOR TV. now blessed with the official seal of Uncle Sam, found itself steeped in affectionate phrases of approval as the public announcement of the historic decision appeared. Said the Commission: "The accomplishment of a compatible color television system that can operate within a 6-megacycle bandwidth is a tribute to the skill and ingenuity of the electronics industry.

In supporting industry through its approval, the FCC declared that it had decided to adopt the new system because there is . . . "virtual unanimity" that the proposed standards are . . . 'fundamentally capable of producing satisfactory color television pictures " and in addition there is . "also substantial agreement" . . . that they "have a potential for growth."

The Commissioners also declared that the system will . . . "furnish incentive and stimulus to manufacturing and research organizations to devote their efforts to the quipment prob-" and that history . demonstrated that American industry is capable of devising practical and economical equipment on a mass production basis . . ." which would eventually reduce the price of receivers and other equipment. The new approach would also afford the consumer, the Commissioners added, a . . . "greater degree of freedom than would an incompatible system in choosing whether or not to purchase a color receiver . . since the public will, in any event, continue to receive program material in monochrome."

In a concurring statement, Commissioner Robert Lee said that he would like to consider the decision . . . "a milestone in the fast-moving electronics industry." In his opinion, the . . . "defects and shortcomings that may now exist will evaporate in the coming months as industry takes on mass production." Continuing, he declared: "The first automobile had many defects. An airplane going on the assembly line immediately takes on some aspects of being outmoded as experience teaches us new improvements and hetter methods of production. We would never learn the new short-cuts if we l:ept the basic idea on the drawing board." Our economy, he felt, will . 'get a tremendous boost from this development.

"I am delighted at long last to have

had a small part in putting the show on the road," he concluded.

In another concurring view, Commissioner George Sterling noted that he was certain that both larger and cheaper color receivers . . . "with controls having the ease of adjustments of current monochrome receivers will be made available to the public within the next two to three years; the time necessary to establish a color television broadcasting service of any consequence."

Commander E. M. Webster also applauded the decision, but issued a stern warning to industry, noting that the adoption of the standards creates . certain receiver problems which must be recognized . . ." Receiver manufacturers, he went on to say . "are obligated to the public to incorporate . . . refinements beyond those in monochrome receivers necessary to suppress adequately aggravated receiver radiation and overcome the greater susceptibility to interference, particularly in the region of the color subcarrier.

The report and order, a 22-page affair supplemented by a comprehensive review of the system's operation, presented some intriguing facts, heretofore not too well known. In a commentary on station costs, the Commission said that color broadcasters will have to spend over \$187,000 for equipment that will permit them to network color programs, and colorcast slides, color films, and live color. To transmit color film, stations will require a 16-mm film chain and miscellaneous gear. For live pickup, at least one three-tube color camera will be needed, and the price offered covers but one unit: it was noted, generally two or more cameras are required for live telecasts. In addition, stations will also require remote equipment, which will add many thousands of dollars to the cost.

The controversial subject of convertibility also received a frank explanation in the report. The Commission declared that . . . "No practical converter has been demonstrated, nor does it appear that proponents of the proposed signal specifications have any current plans for the production of converters."

Describing receivers and their costs. the Commission reported that they were well aware of the fact that the new sets would be high priced and fall

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UHF OUTPUT

SIGNAL

5" High Gain Oscillo-

scope Model S-8202.

Gives rugged, general

purpose performance. 60

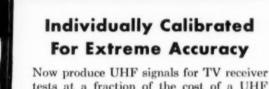
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generator presentations. Wide sweep range (up to 100KC) gives extreme

flexibility in sweep circuit

trouble shooting.

(VHF to UHF)



tests at a fraction of the cost of a UHF generator. Individual calibration guarantees extreme accuracy of UHF frequency. Any VHF signal generator output at 60 MC is converted by the PHILCO Model G-8000-C to UHF. The VHF sweep or marker signal beats against the UHF oscillator, producing UHF signals with the same characteristics as the VHF input signal. It's economical . . . it's a PHILCO exclusive!

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- 1 The VHF signal gener- 4 ator output attenuator controls the UHF output signal level.
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- 3 Each unit is hand 5 High UHF levels, excelcalibrated.
- Functions as an external UHF converter by connecting UHF antenna transmission line to generator's output terminal and connecting lead to TV receiver tuned to 60 MC Channel 3.
  - lent stability, no drift.

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VHF INPUT

60 MC





Mac needs your help! He needs a name for the famous McIntosh output transformer circuit. Just by naming it you can win one of six big prizes. Names may be either technical, for example, "Bicoupled" or non-technical like "Perfectone". Your McIntosh dealer can supply

you with a folder that tells all about the McIntosh circuit. Get one, it will make it easy for you to win. Your entry blank is in the booklet.

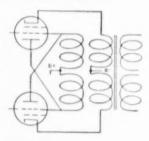
# Six Big Prizes!

1st prize, a McIntosh 50W2 50 watt Amplifier, a McIntosh C-108 Audio Compensator and \$500 cash\*; 2nd prize, McIntosh 50W2 50 watt Amplifier and C-108 Audio Compensator; 3rd prize, McIntosh A-116, 30 watt Amplifier and C-108 Audio Compensator; 4th prize, McIntosh A-116, 30 watt Amplifier; 5th prize, McIntosh C-108 Audio Compensator and D-101 Power Supply; 6th prize, McIntosh C-104 Audio Compensator and D-101 Power Supply.

\*If you are the first prize winner, McIntosh's Chief Engineer will install your equipment and assist you in the selection of other components.

#### The McIntosh Circuit

At right is a drawing of the patented McIntosh output transformer circuit which is not available on any other amplifier. See your Hi-Fi dealer and find out why McIntosh amplifiers guarantee substantially less than ½% distortion at all frequencies 20-20,000 cycles even at full power output. Hear the difference—the difference can be your suggested name. All you have to do then is name it, and you can have it . . . IF you're one of the lucky winners!



#### "Name the McIntosh Circuit" Contest Rules

2. Send in as many entroes as you wish. There is a send in as many entroes as you wish. There is a send of the considering and should be considered and send of 25 words or less as to why you think this name fits the circust or its performance Entries may be on a postered, plain sheet of bookiet available at your hid dealerans. It has bookiet available at your hid dealerans in the

2. All entries are to be mailed to McIntosh Laboratory, Inc., Post Office Box No. 5822.

3. Entries will be judged on the basis of aptress and originality. The decision of the Contest Judges will be final. In the event of a tie, dupli-

the property of McIntosh Laboratory, ing. and will not be returned.

4. The contest is open to all residents of the U.S. and Canada only, and is valid only when permitted by Federal. State and Provincial laws Your entry must be postmarked not later that mignisht. March 31, 1954.

5. Employees of McIntosh Laboratory, Inc., their representatives, advertising agency or familie are not eligible.

6. Winners will be announced in HIGH FIDELITY Mayazine as soon as possible after May 1, 1954 A complete list of winners will be sent to you about May 15, 1954 of a self-addressed, stamped

# Mentosh LABORATORY, INC.

Makers of the World's Finest Amplifiers and Compensators
Manufactured under patent numbers 2.646.467; 2.545.788; 2.654.058; 2.477.074

in the luxury-price brackets of from \$800 to \$1000. Unfortunately, they added, the high cost is caused by the complex three-gun tube, which presently is valued at from \$175 to \$200 at the set-makers' level; this tube, a 15-inch model, provides an 11½-inch picture.

Since the Commission released its statement, several very significant tube cost and size developments have appeared on the scene. It has been reported that it has now become possible to produce a 19-inch tri-color, 3-gun tube, which can provide a 15- to 16-inch picture. A nationally-known laboratory has also demonstrated the practicability of a single-gun tube that can produce a 17-inch picture, and be sold at a substantially lower price that the 3-gun smaller-face model. Commenting on this tube, the lab officials declared that it has good light efficiency, assures automatic registration due to color switching near the phosphor screen and minimizes the problem of convergence. Model shown was a 22inch round type; it was explained that a 21-inch rectangular version will be available soon, and this will probably be followed by a 24-inch model, which will provide 18- and 21- to 22-inch pictures, respectively.

THE ANNUAL REPORT of the Commission, always bulging with valuable information, was equally complete in its '53 version, replete with vital data and statistics. Noting that as the nineteenth year of the Commission closed (June, '53), there were nearly 1,100,000 radio authorizations on its books, the report said that over 235,000 of these were for safety and communications purposes on land, sea, and air, and almost 5500 were for broadcast. Radio station authorizations covered the use of about 600,000 transmitters, of which more than 430,000 were for mobile purposes.

The growing utilization of radio by industry was reflected by nine types of services now operating, for which there are nearly 17,000 authorizations, involving the use of over 127,000 transmitters. These services concern power, petroleum, forest products, relay press, motion picture, agriculture, radio-location/land, and special industrial.

Authorized ham stations were said to number over 112,000. It was noted that the popularity of the new Novice class operator license prompted the issuance of nearly 10,000 licenses during the fiscal-year period ending June 30,

The field engineering and monitoring division of the Commission revealed that they had received over 20,000 complaints on interference; almost twice as many as in '52. Most of the broadcast-interference complaints were due to increased TV operation and the high susceptibility of its reception to interference. Other complaints involved interference from industrial, scientific and medical equipment, and even community antenna systems. Many odd cases of interference were also reported. To illustrate, in the

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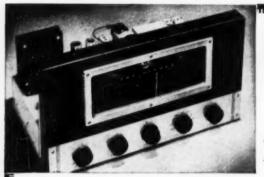
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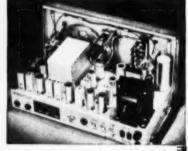
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■ Features extreme sensitivity: (1.5 mv for 20 db of quieting), works where others fail. Armstrong system, adjustable AFC plus switch, adjustable AM selectivity, separate FM and AM front ends. Complete shielding and shockmounting on main and subchassis. Distortion less than 0.04% for 1 volt output. Hum level: better than 90 db below 2 volts output on radio, better than 62 db below output with 10 mv input on phono. Two inputs. Two cathodefollower outputs. Self powered. Six controls: BASS-AC, TREBLE, VOLUME, LOUDNIES, CHANNEL and EQUALIZATION, TUNING.



# FISHER 25-Watt Amplifier 50-WATT PEAK

■ The FISHER Model 70-A Amplifier offers more clean watts per dollar at its price than any amplifier made—25 clean watts for only \$99.50! The 70-A costs no more than "basic" 10-watt units, but has 150% greater power!



■ High output (less than ½% distortion at 25 watts; 0.09% at 10 watts). IM distortion less than 0.5% at 20 watts; 0.2% at 10 watts. Uniform response ±0.1 db, 20-20,000 cycles. Power output constant within 1 db at 25 watts, 15-35,000 cycles. Hum and noise virtually non-measurable thetter than 95 db below full output!) Four separate feedback loops, unique cathode and screen feedback circuit. Outstanding transient response. 8 and 16 ohm outputs. Size: 6½″ x 10½″ x 6½″ high. \$99.50

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spring of '53, interference caused to the International Airport, in East Boston, was traced to a partly broken 4400-volt power cable inside a metal conduit on a high-line pole 2½ miles from the airport.

Reviewing the uses of radio by police, the Commission pointed out that as of June 30, over 8000 police stations held licenses to operate. A normal police radio station, it was noted, consists of a base station, usually located at police headquarters, and a group of radio-equipped cars. These cars may include not only official police cars, but also ambulances and emergency vehicles used to clear highways of obstructions.

The ever-increasing demand for twoway communications, taxing the capacity of the spectrum, also received a thorough analysis in the yearly report. A development that was said to offer considerable promise in alleviating some of the congestion was channelsplitting. The net result of such splitting would be to provide more channels in the same amount of space. It is hoped that during '54 it might be possible to introduce this new technique. The great problem that faces the Commission in introducing the new approach, however, is how such a changeover can be made, especially in the more crowded parts of the spectrum, without too rapid obsolescense of equipment already in use. Supplementing its channel-splitting study, the Commission has initiated a frequency utilization investigation looking toward a revaluation of the frequency requirements of communication services.\*

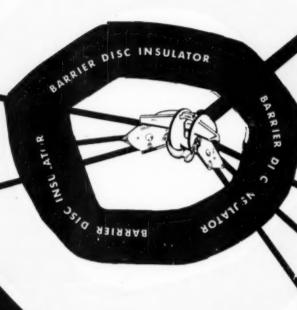
Citizens radio service has also begun to show signs of real life, the annual review revealed. Due to the absence of equipment, the service had been stalemated. In the past year, however, this service has experienced a boom due in part to the availability of commercial gear, and also to the widespread acceptance and use of the recently added 27.255-megacycle frequency, which is available, among other things, for the control of objects such as model airplanes. To encourage further the development and manufacture of lowcost transmitters for this service, the Commission has proposed to relax technical standards applicable to lowpowered equipment of the walkietalkie type.

As of June 30, close to 4000 authorizations had been issued for the Citizens radio service band.

AS A MEANS of helping FM broadcasters improve their financial situations, and at the same time make further use of the FM broadcast band, the Commission has issued a proposal to (Continued on page 165)

• Since the above report was prepared, the Commission has issued a new allocation plan for the 404449 me band. Under the revised programs from 434, 95 me at 100 ke mercust from 434, 95 me at 100 ke mercust from 434, 95 me at 100 ke mercust from 435, 95 me at 100 ke mercust from 436, 95 to 450 95 me, land transportation services received 452, 95 to 452, 95 me and 457, 95 to 457, 95 me and 457, 95 to 458, 95 me. bands; and domestic public services were placed in the 454, 95 to 454, 95 and 459, 95 to 459, 95 me area.





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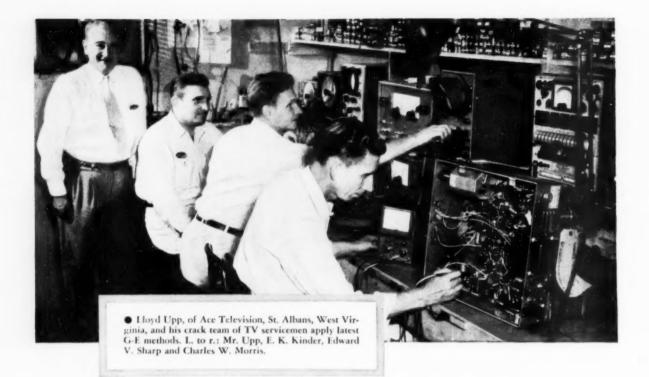
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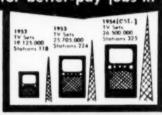
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#### R O O NEEDS THOUSANDS OF TECHNICIANS!

TV is coming into practically every community. More than 2,000 new TV stations authorized in this country alone! Thou sands of new studios being planned and built. All kinds of the sands planned and built. All kinds of new equipment coming on the market. Millions of new TV-set owners will need servicing. It's the rich field of the future with money-making opportunities NOW...if you get in on the ground floor. There just won't be enough TV Technicians to go around. It's your chance of a lifetime for GOOD EARNINGS in a TOP JOB or YOUR OWN BUSI-NESS!











# MORE MONEY AND A CAREER

ARE WAITING FOR YOU HERE!

ARE WAITING FOR YOU HERE!

Earn while you learn by repairing TV sets for friends and neighbors. Many of my students make up to \$25 a week in spare time...pay for their entire training this way... start their own money-making service business. When they complete training and go into TV full time, their earnings zoom into big figures! My graduates are now working at RCA, NBC-TV, CBS-TV, DUMONT TV and numerous other, TV, studios and plants.



TV RECEIVER complete with mammoth picture tube (takes any size up to 21 inch)...also a Super-Het Radio Receiver, RF Signal Generator, Combination Voltmeter-Ammeter-Ohmmeter, C-W Telephone Transmitter, Public Address System, AC-DC Power Supply, and more! 15 full Kits! All tubes supplied, too!

# YOU GET ALL

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### MAIL THIS COUPON NOW! No Salesman Will Call!

Mr. Leonard C. Lane, President RADIO-TELEVISION TRAINING ASSOCIATION 52 East 19th Street, New York 3, N. Y. Dept.T-3B Dear Mr. Lane: Mail me your NEW FREE BOOK. FREE SAMPLE LESSON, and FREE aids that will show me how I can make BIG MONEY IN TELE-VISION. I understand I am under no obligation and no salesman will call.

(	PLEASE P	RINT P	LAINLY)	
NAME.			AGE	
ADDRESS				
CITY		ZONE	STATE	

Radio-FM-TV Technician VETERANS!

Course FM-TV Technician Course TV Cameraman & Studio

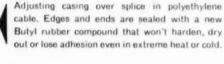
Check here for Training under NEW G.L. Bill

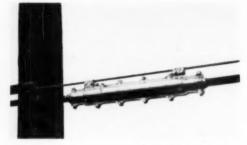


More than ever, light, flexible polyethylene sheathed cable developed by Bell Telephone Laboratories is providing speedy answers to the demand for more telephone service.

But at thousands of splices, the sheath must be thoroughly sealed against moisture. Laboratories engineers developed a protective casing which is quickly and simply bolted in place. The edges and ends of the casing are permanently sealed with a new compound developed by Laboratories rubber chemists.

Now, economical polyethylene cable can be installed much faster and at lower cost. Here is another example of how Bell Laboratories continually finds ways to keep telephone service high in quality, while the cost stays low.





CLOSED CASING IN PLACE

# BELL TELEPHONE LABORATORIES



#### Let me send you FREE the entire story

Just fill out the coupon and mail it. I will send you, free of charge, a copy of "How to Pass FCC License Exams," plus a sample FCC-type Exam, and the amazing new book-let. "Money-Making FCC License let."



EDW. H. GUILFORD

I can train you to pass your FCC License Exams in a minimum of time if you've had any practical radio experience — amateur, Army. Navy, radio servicing, or other. My time-proved plan can help put you, too, on the road to success.

# How to Pass FCC COMMERCIAL Radio Operator

How to Pass LICENSE EXAMINATIONS DOES NOT COVER

AMATEUR LICENSE

FREE

nations, location of examining office, scope of knowledge required. approved way to pre-pare for FCC examinations, positive meth-ed of checking your knowledge before tak-ing the examination. icense

GET YOUR FCC TICKET IN A MINIMUM OF TIME

# Get this Amazing Booklet FREE

# TELLS HOW

## HERE IS YOUR GUARANTEE

GUARANTEE

If you fail to pass your
Commercial License exam
after completing our
course, we guarantee to
continue your training
without additional cost of
any kind, until you successfully obtain your
Commercial license, provided you first sit for this
examination within 90
days after completing our
course.

Army, Navy, radio repair, or

# **TELLS HOW**

# **Employers** make

# JOB OFFERS Like These to Our Graduates Every Month

Letter from nationally-known Airlines, "We would also appreciate if you would place the following additional advertisement in your builetin—Wanted—Superintendent of Communications. Salary 8666 for per month:

Letter from nationally-known airplane manufacturer, "We need men with electronic training or experience in radar maintenance to perform operational check out of radar and other electronics systems. starting salary amounting to \$329.33 per month."

These are just a few examples of the job offers that come to our office periodically. Some licensed radiomen filled each of these jobs . . . it might have been you!

## HERE'S PROOF FCC LICENSES Are OFTEN SE-CURED IN A FEW HOURS OF STUDY WITH OUR COACHING at HOME in SPARE TIME

	III AI WEF	S S I SAI P
Name and Address Lee Worthy 22101/2 Wilshire St., Bakersfield, Calif.	License 2nd Phone	Lessons 16
Clifford E. Vogt Box 1016, Dania, Fla.	1st Phone	20
Francis X, Foerch 38 Beucler PL, Bergenfield, N. J.	1st Phone	38
S Sqt. Ben H. Davis 317 North Roosevelt, Lebanon, III.	1st Phone	28
Albert Schoell	2nd Phone	23

# CLEVELAND INSTITUTE OF RADIO ELECTRONICS CARL E SMITH, E. E., Consulting Engineer, Preside Desk RN-52 — 4900 Euclid Bldg., Cleveland J. Ohio

# **TELLS HOW**

### **Our Amazingly Effective** JOB-FINDING SERVICE

# Helps CIRE Students Get Better Jobs

#### Here are a few recent examples of Job-Finding results

"Your 'Chief Engineer's Bulletin' is a grand way of obtaining employment for your seratures who have obtained their ist class license. Since my name has been on the list! have received calls or letters from the stations in the southern states, and am new employed as Transmitting Engineer at What. Eng. 274, Sparta, Tenn.

Money-Making

FCC Commercial Radio Operator

LICENSE Information

ENGINEERING INCLUDED IN OUR TRAINING & COACHING

"I have obtained a position at Wright-Patterson Air Force Base, Daylon, Ohio, as Junior Electronic Equipment Repairman. The Employment Application you prepared for me had a lot to do with my landing this desirable posities."

Charles E. Loomis, 4516 Genessee Ave., Daylon 6, Ohio,

OURS IS THE ONLY HOME STUDY COURSE WHICH SUPPLIES FCC-TYPE EXAMINATIONS WITH ALL LESSONS AND FINAL TESTS.

"Due to your lob-finding Service, I have been esting many offers from all over the country, and have taken a job with Capital Airlines in Chicage, as Radio Mechanic."

Harry Clare, 4537 S. Drezel Blvd., Chicago, III.

Your FCC Ticket is recognized in all radio fields as proof of your technical ability.

# **Get All 3 FREE**

#### MAIL COUPON NOW

#### CLEVELAND INSTITUTE OF RADIO ELECTRONICS

Desk RN-62 4900 Euclid Bidg., Cleveland 3, Ohio (Address to Desk No. to avoid delay)

I want to know how I can get my FCC ticket in a minimum of time. Send me your FRLE booklet, "How to Pass FCC Liveries Evanimations," those not cover exame for Amsteur Liveries, as well as a Sample Fix type exam and the amazing new booklet, "Minnes Making Fix" Liveries Internation."

Tell me how I can get a TY Engineering Course without additional charge,

NAME

ADDRESS		
	Posts and ZONE STA	

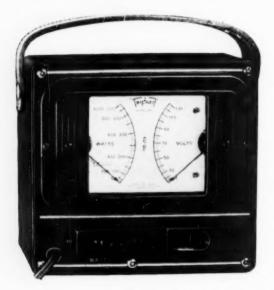
# Bill Clemens says—

Midget Radio Service (a 3-Man Shop) 129 S. Elizabeth St., Lima, Ohio

"TRIPLETT 660 saves us 50 to 100 man hours per month."



1. ISOLATING THE TROUBLE—Plug the power cord of the chassis into LOADCHEK and note the reading. With your eye on the large meter remove the rectifier tube and you can tell immediately which side of the tube the trouble is on. You have already eliminated 50% of your probing time.



2. LOCATING THE SHORT—With Loadchek you can quickly check the shorted side, part by part, without laying down tools or picking up test leads. Here, the trouble was a short in the transformer, spotted without having to warm up set. Overloads are found the same way.

# Locates trouble in a hurry

The above pictures illustrate but one of the many timesaving uses of Triplett 660 Loadchek. This versatile instrument accurately measures power consumption, enables you to see instantly any deviation from normal load, without disconnecting a single part... finds trouble in a hurry.

For Radio and TV servicing—for almost any kind of electrical trouble-shooting—LOADCHEK saves hours of painstaking work every day. At its moderate cost no service technician can afford to be without it. Try one today—and see! Write for free booklet.

TRIPLETT ELECTRICAL INSTRUMENT CO., BLUFFTON, OHIO, U.S.A.



Suggested U. S. A. DEALER NET \$2950

Price subject to change without notice.







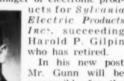
# Within the NDUST

LOUIS DE LA FLEUR of the Federal Communications Commission staff has joined RETMA as manager of the newly-established international department of the Association.

He has been with the FCC since 1940 when he began as an assistant monitoring officer in Baltimore, later becoming chief of the investigating section of the Commission's Radio Intelligence Division in 1946. He subsequently served as chief of the frequency utilization and requirements branch and since 1947 has been assistant chief of that division.

He has served as a member of various U.S. delegations at international conferences. In his new post he will assist RETMA members engaged in export trade.

D. W. GUNN has been appointed general sales manager of electronic prod-



ucts for Sulvania Electric Products Inc., succeeding Harold P. Gilpin who has retired.

Mr. Gunn will be responsible for the sales of products of the radio and tele-

vision tube divisions and the electronics division.

He joined the company in 1931 as a factory engineer at the Salem plant, became a sales engineer for the firm in Chicago in 1936, and since that date has worked successively as a quality engineer, supervisor of quality control, eastern district sales engineer, east central district engineer, and assistant to the general sales manager. Until his new appointment he has been assistant general sales manager of the electronic products sales division.

THE VICTOR DIVISION of RADIO COR-PORATION OF AMERICA has started construction on a group of ultra-modern buildings which will serve as administration and laboratory headquarters for its home instrument and service company activities. The project will be located on a 58-acre tract in the Cherry Hill section of Camden, J. . . HELIPOT CORPORATION. California manufacturer of precision potentiometers, has opened a new eastern plant in Mountainside, N. J. The 20,000 square foot plant will house manufacturing, showroom, and regional office activities . . . JAMES B. LAN-SING SOUND, INC. has moved into a new building adjoining its main building which will be retained for production facilities. The mail address will continue to be 2439 Fletcher Drive, Angeles 39, Calif. . . . SHALL-

CROSS MANUFACTURING CO. of Collingdale, Pa. has recently completed a building program which provides for completely modernized and larger offices as well as increased production and engineering facilities G. C. WILSON & CO., designer and manufacturer of electronic timers, has moved its offices and plant from Chatham. N. J. to 1950 Eighth Ave. in Huntington, W. Va. . . . CHANNEL MASTER CORPORATION of Ellenville, N. Y. recently opened a \$1,500,000 TV antenna plant with a production potential of over four times its present factory. The new plant has 115,000 square feet of floor space and has six separate assembly lines to supplement the two assembly lines in the old plant, which will remain in operation. DAVIS **ELECTRONICS** of Burbank, California, has established two new regional plants to provide faster antenna deliveries. The plant at 8933 Brookville Rd., Silver Spring, Maryland will supply the eastern seaboard while a plant at 5725 N. Central Ave. in Chicago will supply the midwest market JESTIC RADIO & TELEVISION DIVISION has acquired an additional manufacturing plant at 41 Water Street near its main Brooklyn plant. The new structure adds 50,000 square feet of production and warehousing space . . . ROHN MANUFACTURING COMPANY has added a 5000 square foot addition to its plant in Peoria, Ill. This is the third addition to the original plant and gives the firm approximately 24,000 square feet of floor space for the manufacture of TV and communication towers.

LEO HAHN has been promoted to the post of national radio sales manager of

Emerson Radio and Phonograph Corporation.

He has been in charge of sales in the Central Atlantic states and will now head the radio department in the company's sales di-

vision. He will coordinate all radio sales and merchandising by working in close association with the company's regional sales managers, district salesmen, and distributors' sales personnel.

RCA SERVICE COMPANY has developed a comprehensive color training and educational program which will be made available to the entire TV service

The program will provide complete information on the theory and practice of installation and service for color television receiving equipment to the serv-



turn the page, Mister

But, if you're interested in an honest-to-goodness career in the vigorous young electronics industry, here's how you can step ahead of competition, move up to a better job, earn more money, and be sure of holding your technical job even if the brass is firing instead of hiring.

The "how" is CREI training in radio-television-electronics.

You don't have to be a college graduate. You do have to be willing to study—at home. You can do it while holding down a full-time job. Thousands have. Since 1927 CREI has provided alert young men with the technical knowledge that leads to more responsibility, more job security, more money. More than a quarter century of experience qualifies CREI to train you.

What qualifies you for CREI? If you have a high school education, you're off to a good start. If you have a knack for math, so much the better. If you are currently working in some phase of the electronics industry, you'll get going faster. But remember this: CREI starts with fundamentals and takes you along at your own speed. You are not held back by a class, not pushed to keep up with others who have more experience or education. You set your own pace. Your CREI instructors guide you through the lesson material and grade your written work personally. You master the fundamentals, then get into more advanced phases of electronics engineering principles and practice. Finally you may elect training at career level in highly spe-

cialized applications of radio or television engineering or aeronautical radio.

How good is CREI training? Here are a few ways to judge, Ask an electronics engineer if you know one. Ask a high-school or college physics teacher. Ask a radio station engineer, Check up on our professional reputation: CREI home study courses are accredited by the Engineers' Council for Professional Develops ment; CREI is an approved member of the National Council of Technical Schools. Ask personnel managers how they regard a man with a CREI "ticket." Look at this partial listing of organizations that pay CREI to train their own personnel: All American Cables & Radio, Inc., Canadian Aviation Electronics, Ltd., Canadian Broadcasting Corporation, Columbia Broadcasting System, Hoffman Radio Corp., Machlett Labs., Glenn L. Martin Co., Magnavox Co., Pan American Airways, Atlantic Division, RCA Victor Division, United Air Lines. Finally, ask a CREI graduate to tell you about our Placement Bureau, which currently has on file more requests for trained men than we can fill.

What's the next step? The logical one is to get more information than we can cram into one page. The coupon below, properly filled out, will bring you a fact-packed booklet called "Your Future in the New World of Electronics," It includes outlines of courses offered, a resume of career opportunities, full details about the school, and tuition details, It's free.

Note: CREI also offers Resident School instruction, day or evening, in Washington, D.C. New classes start once a month. If you are a veteran discharged at Internation 27, 1950, let the new GI Bill help you obtain resident instruction. Check the coupon for more data.

***************************************		titute • Founded in 1927	TUTE
	in the New World of Electronics" and course autline.  Practical Radio Engineering Broadcast Radio Engineering (AM, FM, TV)	Name	
CHECK FIELD OF GREATEST INTEREST	Practical Television Engineering Aeronautical Radio Engineering TV, FM & Advanced AM Servicing	City	Zone State



ice industry even before the first commercial color sets reach the public. The program is divided into four major elements

One is a series of two-day technical clinics to be held in 65 key cities. The clinics will be conducted by technical specialists of the company, using textbooks, test equipment, and other instructional materials developed especially for these clinics. Service dealers and technicians in each city will be invited to attend

The second phase is a comprehensive textbook "Practical Color Television for the Service Industry." The third area of assistance will be a home-study course, while the fourth aid is a series of test equipment designed for use with color sets.

DAVID J. HOPKINS has been named director of sales for CBS-Columbia, the manufacturing divi-

sion of CBS. Mr. Hopkins resigned his position as director of sales and advertising for Emerson Radio and Phonograph Corporation to take his new post. During

World War II. he served for three and a half years with the Naval Air Arm in the Pacific Theater, attaining the rank of Lieutenant Commander.

CLIFFORD SHEARER has been named advertising manager of Radio Merchandise Sales, Inc. His duties will include handling all advertising and sales pro-. . CBS-Hutron has motion material . promoted CHARLES F. STROMEYER to the position of executive vice-president. He was formerly chief engineer and assistant to the president and later vicepresident in charge of manufacturing and engineering . COLE H. PILCHER has been named director of industrial relations of Sylvania Electric Products Inc. He succeeds HOWARD L. RICH-ARDSON who was recently named vicepresident in charge of engineering operation . . . A. MELVIN SKELLETT, vicepresident in charge of manufacturing and engineering for National Union Radio Corporation, has been elected to the board of directors of the firm . . . Emerson Radio and Phonograph Corporation has appointed M. F. BLAKESLEE to the post of director of distributor relations, a newly-created post with the company . . . DONALD H. ROGERS has been appointed chief engineer of Blonder-Tongue Laboratories of Westfield, N. J. He was formerly associated with Western Electric and Utility Electronics . . . JOHN A. CURTIS has been appointed general sales manager of the Westinghouse Electronic Tube Division . . . ALBERT J. FRANKEL has been promoted to the post of purchasing agent for CBS-Columbia. He was formerly chief buyer . . . RALPH R. STUBBE is the new chief engineer of General Instrument Corporation. He will make his headquarters at the company's Elizabeth, N. J. plant . . . JE-

# **Another Outstanding Service Success Story...**

# with SYLVANIA!

From Basement Repair Shop to prosperous Service Business... featuring Sylvania Tubes, Parts and Promotion Programs! The steady and substantial growth of the Ball Television and Radio Service, from basement shop to the large handsome brick building, shown below, is a tribute to the fair practices and alert policies of the owner, Mr. Ted Ball.



Says Mr. Ball: "My men are as skilled and experienced as any you'll find anywhere, and each is instructed to do the best job possible with the best of parts...and that, of course, includes Sylvania Tubes."

Ted Ball is another important Radio-TV Service Manager that appreciates the quality performance, dependability, and the nation-wide high reputation of Sylvania products.

Mr. Ball also knows about the business-boosting power of Sylvania's promotion and display offers. Find out how Sylvania can step up *your* business. Your friendly Sylvania Distributor is ready and anxious to give you full cooperation. Call him today.

# SYLVANIA

Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y



In Canada, Sylvania Electric (Canada) Ltd., University Tower Bldg. St. Catherine St., Montreal, P. Q.

LIGHTING · RADIO · ELECTRONICS · TELEVISION

# You can build a reputation on Tung-Sol. Quality



TUNG-SOL makes

All-Glass Sealed Beam Lamps,
Miniature Lamps,
Signal Flashers,
Picture Tubes, Radio, TV,
Special Purpose Electron Tubes,
Semiconductor Products.



TUNG-SOL ELECTRIC INC. Newark 4, New Jersey

Sales Offices: Atlanta, Chicago, Columbus, Culver City (Los Angeles), Dallas, Denver, Detroit, Newark, Seattle

ROME V. DEEVY has been appointed director of industrial relations for National Union Radio Corp.... BRUCE K. ARNOLD has been appointed engineer for the eastern division of Cannon Electric Company after twenty-years' experience in production and engineering at the company's Los Angeles factory

... BOB MIDDLETON, formerly with RCA and Precision Apparatus, has joined the sales-engineering division of Simpson Electric Company of Chicago. He will conduct a series of lectures for technicians throughout the country . JOHN P. TANSEY has been appointed national service manager of Motorola's communications and electronic division . . . SAM GROSSMAN, associated with Wholesale Radio Parts. Inc., Baltimore distributing firm, died suddenly at his home at the age of 50. He had been in the electronics field for 30 years and was an active ham with the call W3FT . . . DAVID C. McNEELY has been named sales manager of Helipot Corporation. He will make his headquarters at the company's South Pasadena, California plant . . . P. R. DAWSON has retired from Tung-Sol Electric. Inc. after 34 years with the firm. He plans to make his home in Florida. At the time of his retirement, he was staff assistant to the general sales manager of the company . . JOHN R. HUTSELL has been appointed general sales manager of The Sealtron

Corporation of Cincinnati . . . STANLEY
ADAMS has been named general manager of the Chicago plants of Standard
Coil Products Co. Inc. He was formerly manager of the company's plant at
Bangor, Michigan . . . C. H. FRITZ is
the new assistant sales manager of
Shallcross Manufacturing Company of
Collingdale, Pa. For the past seven
years he was with the company's engineering and sales departments . . .

GEORGE R. LOUX is the new vice-president in charge of manufacturing for the National Company, Inc. He was formerly with Federal Telephone and Radio Company, General Instrument Company, Sylvania, and RCA... HAROLD P. GILPIN, general manager of the electronic sales division of Sylvania Electric Products Inc. has retired after 21 years of service with the company

CHARLES G. SHERWOOD, director

of purchases for Federal Telephone and Radio Company has been named a vice-president of the company... MAURICE SCHOENBRUN has been promoted to the post of director of cabinet engineering for CBS-Columbia... ERNEST B. LOVEMAN, for many years vice-president and general manager of Philoo Television Broadcasting Division, died recently in the reception room of the firm's headquarters plant in Philadelphia. He was 58... OTTO C. BIXLER, director of engineering and research for Magnecord. Inc., has been elected

director of engineering and research for Magnecord. Inc., has been elected vice-president of the firm. He joined the company in 1951 as chief engineer... Schwab Brothers Corporation of New York City has announced the appointment of JOSEPH K. NOLL as vice-president in charge of the firm's mica division... Phen-O-Tron. Inc. has

named RICHARD D. SCHOTTER vicepresident and JACK BAYHA chief engineer of the company's new printed circuit plant in New Rochelle, N. Y. ... YERNE ROBERTS has been named distributor sales manager of I.D.E.A. of Indianapolis.

JOHN C. MARSHALL has been elected a vice-president of Arvin Industries.



Inc. and appointed director of sales for the firm's radiotelevision sales division.

Joining the company in 1928 soon after his graduation from DePauw University, Mr. Mar-

shall has spent his entire business life in sales work. For the past several years he has been director of sales of the company's special products division. He has also served as a member of the firm's board of directors since 1947.

WORKSHOP ASSOCIATES DIVISION of Norwood, Mass. has changed its name to the GABRIEL ELECTRONICS DIVISION of THE GABRIEL COMPANY. The change was required to reflect the broadened scope of the division's operation . John R. Wells, formerly a partner of WELLS & WINEGARD, television accessory manufacturer, has established a new television antenna manufacturing firm in Burlington, Iowa, WELCO MAN-UFACTURING COMPANY . . . COLLINS RADIO COMPANY of Cedar Rapids. Iowa has organized a wholly-owned Canadian subsidiary, COLLINS RADIO COMPANY OF CANADA, LTD. with offices at 74 Sparks St. in Ottawa, On-. SIGHTMASTER CORP. has acquired the complete fuse operation of GENERAL FUSE CO. of South River, N. J. . . . RADIO MERCHANDISE SALES, INC. has acquired the controlling interest in AMES MFG. CORP., manufacturers of a complete line of wire products, and in JEB SALES CORPORATION, producers of a television rotator... CHESAPEAKE INDUSTRIES, INC. of New York has purchased the ALLEN D. CARDWELL MFG. CORP., electronics firm with plants in Plainville, N. Y. and Stamford, Conn.

E. P. GERTSCH has been elected chairman of the West Coast Electronic Manufacturers' Association's Los Angeles Council for 1954.

Serving with Mr. Gertsch are R. G. Leitner of *Packard-Bell* as vice-chairman and Gramer Yarbrough of *American Microphone Company* as secretary-treasurer.

New directors include Ed Grigsby, Altec-Lansing Corp.; Don Duncan, Helipot Corp.; W. V. Phillips, Hoffman Radio Corp.; and Thomas J. Walker, Triad Transformer Mfg. Co.

GENERAL ELECTRIC COMPANY'S Tube Department has received its fifth award for its public relations program on behalf of the service industry.

# Here's the Most Compatible Line of Matched Hi-Fi Components

in the industry today!





**Dual Coaxial Speaker A1-400** 



Preamplifier-Control Unit A1-200



Power Amplifier A1-300





Speaker Enclosure (Bland, Mahogany or Unfinished Veneers) A1-406

From stylus to speaker General Electric designs...engineers...and manufactures more of its own components than any other company. The result: matched equipment worthy of the name! Forget about stocking many different brands and offer customers one integrated sound system that minimizes distortion.

Remember, you are already a sales step ahead with the famous General Electric cartridge. No other high quality line is as complete ... as preferred... as outstanding in performance and price as G-E! And, people everywhere who listen once to the complete Custom Music Ensemble then look at its low price tag, sell themselves. To go places in the Hi-Fi business . . . go all the way with G.E.! For complete information, mail the coupon below, today.

# G-E VARIABLE RELUCTANCE CARTRIDGES





Why you should use a G-E Diamond Stylus Cartridge.

All records cause stylus wear. The result: reduced record life and performance. Tests conducted on diamond styli have run hundreds of hours with no audible distortion and only highlights on the styli to indicate visible wear.

General	Ele	ectric	Company,	Secti	ion	R934
Electron	ics	Park,	Syracuse,	New	Ye	ork.

Send me information on all units in the G-E high-fidelity equipment line,

not the first like and first this tree first and give and out out on the first the



= GENERAL (28) ELECTRIC ===





No other broadcast and shortwave receiver gives you 8 tubes plus rectifier at this moderate price! And no other receiver offers you all 8 of these big performance features:

(1) Caribrated bandspread for 80, 40, 20, 15, 11 and 10 meter bands on large, indirectly-lighted lucite scales), with miminum parallax (2) delayed AVC, (3) exceptional sensitivity, (4) new miniature tubes used exclusively, (5) antenna trimmer, (6) outstanding selectivity, (7) 8 tubes plus rectifier. (8) most compact.

Covers 540 kcs. to 40 mcs. in 9 bands (5 bandspread, 4 general coverage). Has tuned RF stage, 2 1F stages, 2 audio stages with phono input and tone control. Built-in speaker with provision for external speaker if desired.

FREE! Catalog of National receivers and components. Write Dept. RN 354.





The National Alliance of Television and Electronic Service Associations presented its award to the firm for the second straight year, citing the Tube Department "for outstanding service to television service management in creating better customer relations."

Previous awards include those from NATESA, Associated Radio and Television Service Dealers, Inc. of Columbus, Ohio, The Federation of Radio Servicemen's Associations of Philadelphia, and RTG of Boston.

JOHN N. PHILLIPS has been named manager of color television products



engineering for General Electric Company's radio and television department while Carroll R. Miner has been appointed to a similar post for monochrome products.

The two new appointments are part of the firm's reorganization plan to gear the television product engineering department for the mass production of color television receivers.

Mr. Phillips graduated from Union College in 1940 and joined the company immediately following his graduation.

Mr. Miner has been with *G-E* for 25 years and was a member of the original engineering group at Schenectady in 1934. Until recently he was manager of TV product engineering.

**DeVRY TECHNICAL INSTITUTE** is the new name for the television, radio, electronics school formerly known as *DeForest's Training, Inc.* 

The renamed school will occupy new quarters at 4141 W. Belmont Ave. in Chicago.

WORLD RADIO LABORATORIES, Council Bluffs, Iowa distributor, suffered a disastrous fire on January 3rd which completely destroyed its store.

According to Leo Meyerson, head of the firm, plans have now been completed for moving into a new ultramodern fireproof plant at 3415-27 W. Broadway, Council Bluffs. The new building contains 30,000 square feet of floor space plus an additional 30,000 square feet of customer parking area.

Mr. Meyerson also announced that no attempt would be made to salvage equipment from the burned out building and that all equipment would be new, as will be all components used in reconditioning ham gear in the Used Amateur Equipment Division.

Copies of the company's 1954 catalogue are available from the company at its new address,

DALMO VICTOR COMPANY, San Carlos, California electronics firm, has been sold to *Textron Incorporated*, a textile firm.

Dalmo Victor has become a subsidiary of the parent company but will continue under present management.

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34

# 

· · · easy to win

503 PRIZES \$2000-1st prize

\$500 - 2nd prize, 100 - \$10 prizes, \$100 - 3rd prize

# HOW TO WIN

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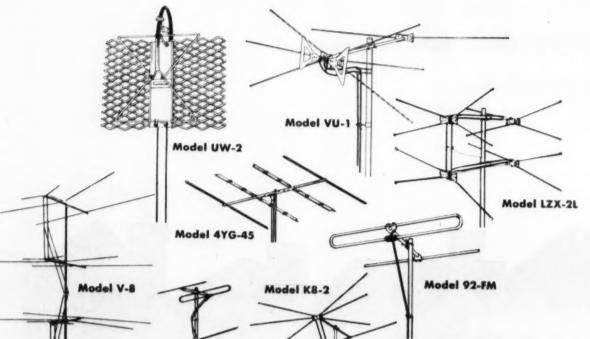
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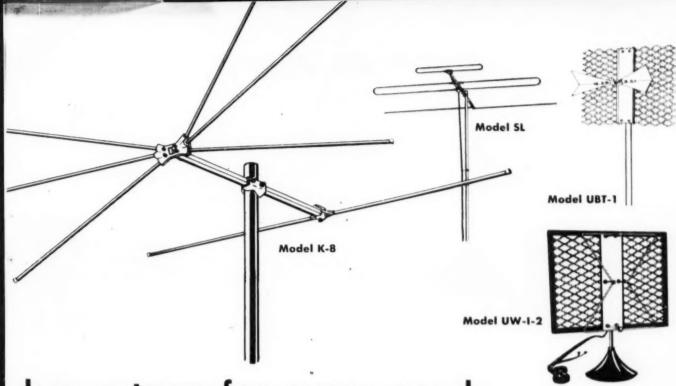
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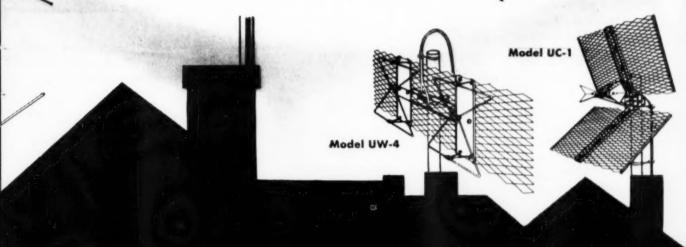
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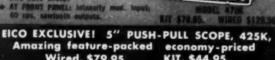
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# LOOKING AHEAD

#### By HAROLD J. SCHULMAN

Chairman, Service Committee, RETMA

An appraisal of the status of servicing today, and of the new opportunities for service technicians in u.h.f. and color TV, hi-fi, and tape recording.

RIGHT at this moment more than thirty million television receivers are plugged into handy wall sockets. A simple "twist of the wrist" and a "window on the world" is brought into being in thirty million homes.

Ten years ago, you could have been a millionaire and still not have been able to enjoy the magic of big screen television that we take for granted today. This modern miracle was made possible by teamwork such as exists in no other industry. Receiver manufacturers conceived and produced this wonder-child. The broadcasters give it its daily sustenance. And service technicians keep it alive. Without the combined efforts of these main segments of our industry, television as we know it today could not come to pass. The service technician is not just a repairman, installer, or tinkerer. He is a most important member of the team helping to make electronic developments enrich the lives of all of us.

What can we look forward to in television service? With the FCC approval of compatible color, this question almost answers itself. But let's for the moment look back a bit to

see where we are today.

Television service has passed through several distinct stages. The first, or introductory stage, featured factory sponsored or controlled one-year service contracts. Many manufacturers, either through their own organizations or their distributors, encouraged the sale of factory service contracts. This led to the build-up of giant service companies, some good—some bad.

Changing times brought the decline of the large service company. A number of factors helped this along. Receiver prices came down. The cost of a service contract thus looked high in relation to the cost of the set. Design improvements and competitive conditions also combined to encourage the consumer to risk owning a set without service contract coverage. Also, too many service companies were closing their doors, leaving angry contract owners with nothing more than worthless pieces of paper to show for their money.

All this led to a trend away from the service contract. Independent service technicians, some of them former employees of the larger companies, started taking over more of the available service work on a charge-per-call basis. Moderate-size service companies and dealer service organizations completed the group then handling the country's service requirements. This is mostly on a charge-per-call basis.

Of course, there are occasional exceptions where a large well-managed service organization survived and thrived. But the trend is definitely to smaller organizations and independent service technicians. It is interesting to note that even a major factory service organization is pulling in its large-scale horns. A trade report says that it is selling or closing its service company branches in cities with less than 100,000 population.

While the consolidation of this trend was going on, u.h.f. bounced on the scene. The educational process started all over again. Experienced service technicians had to learn new techniques. Newcomers in newly opened areas really had to scratch around a bit to get things rolling right.

H. J. SCHULMAN—studied electronics at Syracuse University and business administration at N. Y. U. During the war, served in the Alf Force doing radar maintenance and teaching radar. After the war, had a retail radio and TV sales and service business in New York. Was TV service manager for Admiral distributor in New York City, and has been Director of Service at Allen B. Du Mont Labs, for past three years. Co-authored a TV troubleshooting course for a correspondence school, and assisted in the preparation of a TV booklet for the New York City Better Business Bureau, subsequently adopted by the Radio-Electronics Television Manufacturers Association.



New u.h.f. antennas had to be put up. The tricks played by different transmission lines had to be mastered. The "why's" and "wherefore's" of strips, converters, and all-channel tuners had to be learned.

To add to the national work load, some v.h.f. stations switched channels in line with FCC recommendations. Set owners in these areas usually found some change in their reception. Sometimes it was better, sometimes worse. Where it was worse, the service technician heard about it.

That the service technician has been able to keep up with the changing scene—and for the most part, very admirably—is attested again by the latest Elmo Roper survey. Again Roper concluded that the overwhelming majority of television set owners was pleased with the service they received when they needed it.

This is a great tribute to the men in the service field. Thirty million television receivers—600 million television sockets with tubes that can, and often do, go bad, all in operation today, give us a feeling of confidence that the service industry will be able to meet new challenges with flying colors.

The service technician can be expected to take on increasing work on hi-fi equipment and tape recorders. But the main problem will still be black-and-white television in existing and ever increasing markets. Much emphasis will be in u.h.f. as more and more u.h.f. transmitters hit the air.

The main challenge, of course, will be color. This year can be called the "Year of Preparation" for color TV service technicians. The main emphasis at this point should be towards acquiring a good theoretical understanding of the NTSC signal.

At this writing there are no production line color sets available. This means that no one has reliable statistics or experience on color sets as they will roll out of the factories this fall.

Early indications show that for the most part the same broadband antennas used in black and white will be suitable for color. Narrowband antennas, or those with sharp dips at the color subcarrier frequency, may cause some trouble and will have to be watched carefully.

The installer will have to learn how to insert the color tube in the cabinet. According to current information, color picture tubes will most likely be shipped out of the cabinet. The installer will also have to set up a new series of color adjustments as well as spend more time teaching the customer how to tune in (Continued on page 143)



ITH the somewhat confused and uncertain market conditions caused partly by the advent of color TV and partly by the general slack in business, the television industry has prepared its 1954 models with great care. Shying away from radical innovations, most manufacturers have emphasized price, quality, and ease of servicing in their new designs. Most models feature time-tested electronic circuits, with improved mechanical design, and better layout for easier servicing and simpler assembly methods. Two new electrical features appear in almost every major TV line; highfidelity sound, and a full u.h.f.-v.h.f. band tuner

High fidelity has proven to be such good business that many TV manufacturers have diverted some of their facilities to radio-phonograph combinations, while others offer TV receivers with greatly improved sound quality, phono attachments, AM-FM combinations, etc. There are even TV sets on the market using two speakers, pushpull output amplifiers, and connections for tape recorders and record players.

The second feature, an 82-channel tuner, is incorporated in most of the better lines. The September 1953 issue of Radio & Television News described the Standard Coil Products 82-channel detent tuner which is used in TV sets made by Admiral, Emerson, Hoffman, CBS-Columbia, Majestic, Olympic, Packard-Bell, Stewart-Warner, and several others. The outstanding features of this tuner are the fact that it is a single conversion system, uses straight detent turret switching, and permits selection of each of the 82 channels simply by setting the two concentric dials until the desired channel number appears. This tuner is shown in Fig. 1.

Most of the other 82-channel tuners consist of a detent-type v.h.f. tuner, and a continuous-type u.h.f. tuner. These, however, were fairly common in 1953 models.

Before discussing individual new de-

signs, the subject of color receivers deserves some mention. At the time of publication color TV sets are still as scarce as solid gold Cadillacs. During the second half of 1954, however, some color receivers will appear at the dealers. From current engineering plans it appears that practically all major manufacturers will use basically the same circuit, a type of "630" of the color variety. In a subsequent issue a detailed description of this first color receiver will appear, but for the present only some of its features can be mentioned.

The first color receivers will use a shadow mask tube, either the RCA tri-color tube, which is being produced by other manufacturers as well, or the CBS-Hytron "Colortron" which is a simplified version of the RCA tube. Most color receivers will use 82-channel tuners. It is expected that the color decoder section will be a separate sub-chassis, probably identical in all sets, and eventually as standardized as TV tuners. The i.f. section of all color sets will use the 41 mc. band and feature "bridged-T" rejection filters of great efficiency. The i.f. response curve must be flat to 4 mc. from the video carrier while the sound i.f., 45 mc. from the video carrier, must be at least 60 db down to avoid sound interference. These requirements will focus special attention on i.f. alignment both at the factory and by the service technician. Practically all aspects of the color sets will be new, but space does not permit a detailed discussion here.

#### New Electronic Designs

Instead of producing different TV receiver models for normal reception areas and for fringe areas, most manufacturers incorporate some type of adjustment for sensitivity in a single model. Two major systems are used to get better fringe area performance. One system makes use of a switch or potentiometer to set the level for the a.g.c., the other system concentrates on improving the sync action in the

presence of noise or weak sync pulses. In Fig. 2 are shown two versions of the Admiral "DX Range Finder." The a.g.c. system in Fig. 2A is a simple diode type and the "DX Range Finder" control sets the d.c. level of the bias voltage. The cathode of the a.g.c. diode is biased positively by the action of the voltage divider  $R_{222}$  and  $R_{231}$ , the contrast control. When maximum contrast is desired, the cathode of the video amplifier is grounded, putting the entire 1000 ohms of  $R_{\text{sn}}$  in series with the a.g.c. diode and making the a.g.c. cathode quite positive. In addition to this variable voltage divider, a fixed network Ram and Ram also has control over the d.c. level at the a.g.c. diode cathode. The total effect of these two voltage dividers is to allow an increase in positive delay voltage, and therefore a decrease in a.g.c. bias when the contrast control is turned up. The potentiometer  $R_{335}$  together with  $R_{336}$  $C_{100}$ , and  $C_{210}$  form the time constant of the charging network for the a.g.c. diode. When  $R_{114}$  is set for maximum resistance, the developed a.g.c. bias will correspond to the peak sync pulse level of the video carrier, a condition desired in strong signal areas. As  $R_{115}$ is reduced, the time constant becomes shorter until the developed bias corresponds only to the average video carrier voltage. The reduced bias will provide more i.f. gain; at the same time, the short time constant does not allow the a.g.c. to be affected by strong noise pulses. The result is that both sensitivity and neise immunity are adjustable for each location.

In Fig. 2B is shown the a.g.c. circuit for the Admiral 22F series. In this chassis a keyed a.g.c. system is used and the "DX Range Finder" control sets the grid bias level of the a.g.c. tube. The grid bias of this tube controls the final a.g.c. voltage, but is determined itself by the amplitude of the horizontal sync pulses applied to the grid. Resistors  $R_{231}$  and  $R_{342}$  form a voltage divider controlling the d.c. bias on the a.g.c. tube. By adjusting  $R_{342}$  the final a.g.c. level is set, just as in the circuit of Fig. 2A.

In many other receivers, such as the 1954 Majestic, the fringe control simply consists of an additional resistor in the a.g.c. bias network which is switched in or out to reduce or increase the total bias. A variation of

RADIO & TELEVISION NEWS

# DESIGNS FOR 1954

#### By ROBERT B. GARY

#### A few new circuits and improved mechanical layout for better serviceability are the highlights of 1954 sets.

the fringe switch is found in the new Westinghouse V2240 chassis which uses a triode in a keyed a.g.c. circuit. In this unit the a.g.c. cathode is at 140 volts positive for local stations, allowing a certain a.g.c. voltage as determined by the flyback pulse and the composite video signal amplitude. For fringe operation a resistor in series with the cathode is shorted out by the fringe switch and the cathode potential is increased to 150 volts. This reduces the tube current and therefore the a.g.c. bias.

A second type of fringe area improvement is illustrated in Fig. 3, the sync pulse clipper used in the 1954 Raytheon models. The 6BE6 pentagrid tube receives two different video signals, one from the 2nd detector and the other from the video amplifier. The signal from the detector is applied to the control grid and is positive in polarity. The gating grid receives a much stronger negative signal from the video amplifier. By setting the d.c. voltage on the control grid, the level of clipping is set so that only the top of the sync pulse is passed by this tube. Since the tube can conduct only during the sync pulse period, noise pulses occurring during the video portion of the signal cannot pass the tube. Resistor Ren, called the "sync stabilizer" permits adjusting the operating level for the sync clipper tube for optimum performance in a particular area.

The new Emerson receivers feature a very effective sync stabilizing system which actually amplifies and inverts noise pulses so that cancellation of noise pulses is possible. When a noise pulse is greater in amplitude than the horizontal synchronizing pulse, it is amplified in a triode section and then fed back, in opposite polarity and slightly stronger than the original signal. The cancellation of strong noise pulses results in more stable sync action. For fringe area operation a potentiometer and "on-off" switch permit both a fine and rough level setting to determine at just what amplitude the noise inverter tube should function. This tube's bias level is set by the fringe compensator so that the tube is cut off for sync pulses, but any pulse higher than the sync level will set off the cancellation scheme. A similar noise cancellation system, but without the adjustable features, is found in the new Phileo TV models.

Another new feature in many 1954 models is the higher i.f. of 41 to 45 mc. Although a few of the 1953 TV sets used these new frequencies, practically all manufacturers have switched to the higher i.f. for 1954. An increasing number of TV manufacturers use the new RCA printed circuit i.f. strip. For the service technician the higher i.f. range means a whole new set of interference problems, mostly due to local police broadcasts which are often in the 40 mc. band. (See article on TV interference in the July 1953 issue of Radio & Television News).

Concerning the printed circuit i.f. section, good grounding is essential in all alignment and troubleshooting because the entire i.f. assembly is subject to regeneration and oscillation.

In tune with the economy and power conservation policy followed in most late models, most manufacturers have arranged the d.c. power distribution for maximum efficiency and minimum losses in bleeder resistors. A typical example of this is shown in Fig. 4, the "B+" circuit of the Admiral 19B1 receiver series. In this system there is a total of five different branches for the d.c. power. The fuse is used to protect the high voltage flyback and "B+" boost voltage, isolating any breakdown in this section.

#### Mechanical Features

The 1954 Zenith models have two rather unique features as shown in Fig. 5. The speaker is retractable and can

Fig. 2. Admiral, among others, uses a potentiometer to regulate the sensitivity of the receiver for fringe and normal viewing. The circuit in (A) is from the 19B1 series, the circuit in (B) is from the 22F chassis.

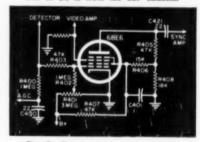
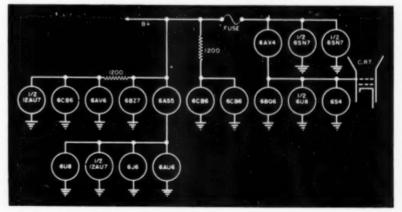


Fig. 3. Circuit of sync clipper used in Raytheon's 1954 TV receiver line.

be pushed out of sight when the set is not in use. One advantage of this design is the compact cabinet size and the fact that the impression is given that the sound originates directly from the screen. This is some improvement

Fig. 4. The "B+" distribution diagram for the Admiral 1981 series chassis,



over the usual practice of mounting the speaker on the side, at the rear. A drawback is the fact that the mechanical arrangement for the retracting of the speaker is subject to various defects and although good sound is claimed by the manufacturer, the lack of any sort of baffle is hardly an improvement.

The second unique feature of the Zenith line is the channel selector. As seen in the illustration of Fig. 5, the selected channel lights up in large numbers at the center of the dial. This is a good sales feature since it makes it possible to see the operating channel number in the dark and at a distance. For the service technician this presents another possible mechanical troublespot for, in addition to burned out pilot lights, the switching arrangement is subject to friction and wear.

As mentioned in the beginning of this article, most manufacturers have also made some efforts to include features in their 1954 models which will appeal to the service technician since it is now understood that many sales are the result of the service technician's recommendation.

Among the "service engineered" new 1954 models is the Stewart-Warner "Thunderbolt" line as shown in Figs. 6 and 7. Fig. 6 shows a cleverly designed U-bracket which supports the deflection yoke assembly and at the same time permits the service technician to turn the chassis upside down for easier servicing. This bracket can also be used as a handle for pulling the chassis from the cabinet, carrying it, resting the chassis on either side, and rolling it over as might be needed. In addition, the U-bracket eliminates the customary center bracket which usually makes some of the tubes hard to reach. The circuit layout of this chassis is designed for greatest accessibility, all tubes can be reached with the receiver in the cabinet, and highvoltage fuse replacement can be effected from the rear without soldering or removing the chassis.

A further boon to the technician is

the fact that both deflection yoke and high-voltage transformer can be replaced from the rear of the receiver, without soldering connections. Fig. 7 shows how to disconnect and remove the flyback transformer. All connector plugs are color coded to avoid errors.

Many other TV manufacturers use plug-in arrangements for the focus coil and deflection yoke to allow for easier replacement, and accessible fuses are also found frequently. The new Majestic receivers even use two separate fuses in snap-on holders. One fuse, a 3 amp. type, protects the entire receiver, while a regular ¼ amp. fuse is used for the high-voltage section.

Since many TV sets sold in 1954 will have u.h.f. channels added or may require changing of tuner coil plates. several leading TV manufacturers provide access doors underneath the tuner assembly. Majestic and Packard-Bell receivers, as well as other popular brands, have a small trap door, set into the cabinet bottom of the table models for this purpose. It will usually be necessary to remove the tuning knobs and adjust the oscillator frequency with a tuning rod from the front panel. In many cases where the tuning slug has been pushed in too far during adjustment it will no longer be necessary to remove the entire chassis for correction.

Another good idea in TV design is the use of a removable safety glass on the front of the cabinet. While many manufacturers have used this in the past, it is only now gaining widespread acceptance. Some receivers, like the new Packard-Bell models, use a tilted safety glass, mounted on soft rubber, which is easily removable and can be cleaned and replaced without affecting any other part of the television receiver.

Surveying the innovations for 1954 we find that they include many welcome features which are expected to ease the burden of the service technician. A number of manufacturers have obviously consulted their service departments before settling on any new design and the result will be felt by both manufacturer and customer. Other features are based on economy, such as the fairly widespread use of selenium rectifier supplies instead of the more expensive power transformer and tube combination.

Most components and circuits have already become standardized and apparently few actual improvements are possible at this time. It is more economical to use a proven system for which all parts are readily available than embark on new developments which usually require special components and a lot of expensive engineering, field testing, and modifying afterwards.

The trend in TV picture tubes is definitely towards the 21, 24, and 27 inch sizes. The new popular screen will be at least 21 inches. A good quantity of 27-inch tubes in economy style cabinets is also expected to be marketed.





Fig. 1. The v.f.o. and transmitter set-up. The author uses his unit with a Heath Model AT-1 transmitter kit, but it will work with other transmitters.

WHILE crystal-controlled transmitters are usually the most economical to build or buy, they are not always desirable for use in crowded areas of the amateur bands. A simple v.f.o. is just the thing to avoid interference, especially when applied to low-powered transmitters and limited antenna space. Since a v.f.o. can be a tremendous help, it is worth the time spent in constructing one.

A typical v.f.o. and transmitter set-

up is shown in Fig. 1.

The Heath Model AT-1 transmitter kit was chosen because of its economy and bandswitching facilities. Power for the v.f.o. is supplied by the transmitter through an octal socket mounted on the rear of the chassis.

A series-tuned Colpitts oscillator circuit is used as shown in Fig. 2. The grid coupling condenser which is usually used in this type of circuit has been omitted because the circuit will work with or without it. The 6AQ5 miniature tube, mounted to the right of the 0A2 regulator, uses less space in the 3"x4"x5" aluminum box than the equivalent 6V6.

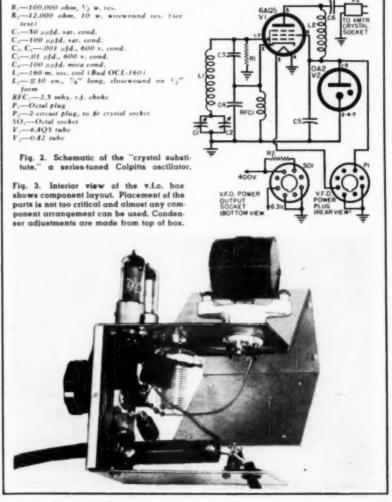
Oscillations are prevented by operating the v.f.o. on 160 meters and its output on 80 meters. The oscillator coil is a standard Bud OCL-160 which its a five-prong socket. The oscillator plate coil is resonant about the middle of the 80-meter band and requires no

tuning.

Instead of mounting the series resistor inside the v.f.o. box, it was mounted between pins four and five of the v.f.o. power output socket on the transmitter chassis. This eliminates heat accumulation in the v.f.o. box. The plate voltage for the v.f.o. is obtained from pin 5 on the socket instead of pin 4. In case this particular transmitter is not used, provisions should be made to mount the resistor outside the box, preferably inside the transmitter chassis.

The key jack on the front of the oscillator unit is not used. Originally, the oscillator was to be keyed for break-in operation. But since the (Continued on page 122)

Build this compact v.f.o. for your crystal-controlled transmitter. The unit uses standard parts throughout.





ERHAPS less than in any other trade do the five senses of the TV technician directly serve their possessor. Occasionally an overloaded resistor, arced transformer, or shorted condenser may make itself evident to the sense of smell; some faults announce themselves to the sense of hearing as noisy, distorted, or weak sound; other faults display their character in the form of picture distortions; overheated transformers, tubes, and resistors are evident to the sense of touch; and some gross mechanical failures, such as broken leads, may be directly visible. In the main, however, the majority of faults which occur in a TV chassis can be revealed only by means of suitable test equipment. The components of a TV chassis appear quiescent and uninformative to the unaided eye, but when investigated with suitable instruments exhibit myriads of rapid electrical actions. Oscilloscopes, vacuum tube voltmeters, and similar instruments are extensions of sense, particularly the sense of sight, which enable the operator to peer into the innermost activities of electrical circuits.

#### Sweep Generators

Among the major circuits of a TV receiver are the tuned signal circuits, comprising the r.f. mixer and i.f. amplifiers. Practically all receiver service data provides average response curves of voltage vs frequency for these circuits, and responses of the type shown in Fig. 1 are quite familiar to most TV technicians. Less well known, perhaps, are the requirements for suitable sweep generators for such applications. In general, the r.f. circuits of the receiver impose the severest demands upon a sweep generator and the user of the instrument is concerned with the following performance factors:

 Is the sweep generator a true r.f. sweeper, or is it primarily an i.f. sweeper, relying upon harmonic output for high-band coverage?

2. Does the sweep generator have sufficient output on the high channels to obtain satisfactory scope deflection?

3. Is the attenuator satisfactory for r.f. sweeping, providing control of the output voltage without distorting the response curve at various settings?

4. Most important of all, is the output voltage from the sweep generator flat within plus-or-minus 10% over the swept band?

The output from an r.f. sweep generator should be at least 0.1 volt on channel 13. The gain of a front end is usually least on the high channels, but if the stated amount of output is available, a reasonable amount of scope deflection can be obtained, even if the front end is not in peak alignment at



By

#### ROBERT G. MIDDLETON

Author, "TV Troubleshooting Guide"

the outset. The gain on channel 2 is usually about double the gain of the front end on channel 13, hence, the full output of the generator is not required for low-band alignment.

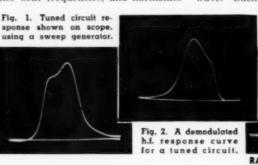
The attenuators should be of lowimpedance construction, to avoid resonances and partial resonances which cause lack of flatness in the output at various operating frequencies. The flatness of a sweep generator is easily tested with the aid of a crystal demodulator probe and scope, as shown in Fig. 7A. The pattern which is obtained on the scope screen will be quite flat over the swept trace as in Fig. 7B, if the output voltage from the sweep generator is uniform over the swept band. However, the swept trace will be uneven, or wavy as in Fig. 7C, if the output voltage from the sweep generator is not uniform. The extent of nonuniformity is usually observed with respect to a zero-volt reference line: there are various methods of obtaining zero-volt reference lines, but the usual method is to use the retraceblanking function provided by many sweep generators.

Some caution should be observed, however, when checking the output from very simple types of beat-frequency sweep generators, since the output is often a mixed output, comprising feedthrough frequencies from the beating oscillators, sum and difference beat frequencies, and harmonics

of these frequencies. In consequence, the flatness check is not necessarily valid unless the operator utilizes suitable output filters to remove the unwanted frequencies. It is quite possible, for example, for the fundamental output from a sweep generator to be quite flat, while the second-harmonic output may be far from flat, due to partial resonances in the output system. For this reason, the operator should be certain to study the circuit diagram of the sweep generator before tests are made, and to provide suitable filters, if required. Sometimes low-pass filters are built into the generator, and sometimes they are provided as accessory units. In other cases, the technician will have to make use of 75-ohm filters which have been designed primarily for other applications.

#### Oscilloscopes

A common misconception concerning scopes for use in alignment work is that 4 mc. bandwidth is believed to be required. Nothing could be farther from the facts of the matter, and no other application of the scope requires less bandwidth than does visual alignment. The chief point to keep in mind is that a visual response curve, as shown in Fig. 2, for example, is a demodulated response, and belongs to the same general class of waveforms characterized by a 60-cycle square wave. Such waveforms are properly



wave. Such waveform demands good l.f. response.

Fig. 3. 60-cycle square

RADIO & TELEVISION NEWS



Fig. 7. (A) Test set-up used to check flatness of output from sweep generator. (B) Flat output. (C) Poor output, varying 2:1.

#### Since test gear represents a major investment for the technician, its selection requires careful planning.

displayed by scopes having vertical amplifier response down to 20 cycles per second. The upper frequency limit need not be more than 1 kc. In fact, when the upper frequency limit is high, such as 2, 3, or 4 mc., the marker indication will be very poor. matter is reserved for later discussion.

It is sometimes asked why the lowfrequency response of a scope must extend down to 20 cycles per second to properly reproduce a 60-cycle square The reason for this requirewave. ment is that the phase characteristic of the vertical amplifier is just as important as the frequency characteristic. Unless the phase characteristic is linear, the reproduced square wave will exhibit tilt, and the phase characteristic cannot remain linear at 60 cycles unless the frequency response is sustained to 20 cycles, or lower.

The sensitivity of a scope used in visual-alignment work should be relatively high, in order to obtain satisfactory pattern displays in r.f. alignment work. It has been seen that a sweep generator may have limited output on the high band, and this deficiency can be compensated, to some extent, by using a high-gain scope. Many presentday service scopes provide a sensitivity of 10 millivolts per inch, which is ample for alignment work.

#### Marker Generators

accuracy of frequency indication which can be obtained from sweep generators, and limit the extent of horizontal linearity which can be realized, as well as the accuracy of the sweep-width calibration. If these three functions could be maintained to a high degree of accuracy, a marker generator would not be required. However, a marker generator is almost always utilized in practical work.

A typical beat marker, or birdie, is shown in Fig. 4. The marker is obtained by mixing the output from a signal generator, termed a marker generator, with the FM sweep signal. A beat occurs in the circuits under test, and the zero-beat point, or maximum marker excursion, corresponds to the dial indication of the marker generator. Unless the bandwidth of the scope is restricted, the marker will appear very broad and fuzzy on the response curve. Sharp markers, such as seen in Fig. 4, can be obtained when using wideband scopes by shunting a fixed condenser of suitable value across the vertical input terminals of the

The accuracy of the marker depends upon the type of circuit which is under test. For general i.f. alignment work, a generator which is accurate within ± 2% is usually satisfactory. However, the accuracy required for sound i.f. and ratio detector work, as illustrated in Fig. 5, is very strict, and very few marker generators can meet the requirements. The majority of test equipment manufacturers recommend that the technician utilize a 4.5 mc. marking crystal, instead of a generator, for this application. Many marker generators and sweep generators contain 4.5 mc. crystal oscillators to meet this requirement. However, if the marker generator provides for calibration checks, it is often possible to use the generator output for sound i.f. work. The accuracy of calibration should be within ± 1 kc.

One of the difficulties encountered in ratio detector marking is the AM rejection of the circuit, which wipes out the marker from the center of the "S" curve, as seen in Fig. 5. The visibility of the marker can be improved in double-ended ratio detector circuits by opening the stabilizing condenser during the alignment. In the case of single-ended ratio detector circuits, the most practical method of marking is provided by a bypass marker injector which develops the beat marker independently of the tuned circuits in the receiver.

Spurious markers, shown in Fig. 6, often arise to plague the user of sweep and marker generators. In most cases, the spurious markers are caused by beating of spurious outputs from the generators, although improper test conditions can also give rise to spurious markers. For example, if the local oscillator is not disabled during i.f. alignment, harmonics of the local oscillator frequency will almost certainly cross beat with harmonics of the sweep and marker generators to produce spurious markers and spurious sweeps which distort the shape of the i.f. response curve.

When running r.f. response curves, the local oscillator must be kept in operation to avoid distortion of the response curve as a result of improper mixer bias. Hence, the operator is sometimes troubled with cross beats of oscillator output with sweep and marker voltages and their harmonics. However, these sources of difficulty are much less frequent than in i.f. work, Unless the sweep generator has a very

(Continued on page 144)



Practical considerations limit the

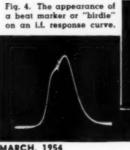


Fig. S. An FM ratio detector "S" curve. See text for explanation.

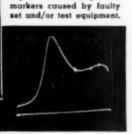
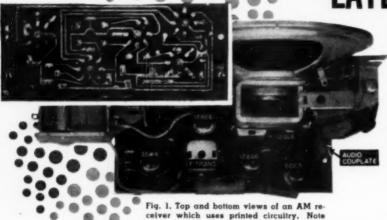


Fig. 6. Curve with spurious

**MARCH, 1954** 

## LATEST TRENDS IN



The "new look" in radio sets with ferrite antennas and printed circuitry requires some new service techniques.

that in this chassis all components are

on one side and the wiring on the other.

EVERYONE has been so preoccupied with television these last few years that not much attention, editorial or otherwise, has been given to radio. Yet it takes but a glance at current statistics to reveal that radio production is greater than ever, more numerous by far than television.

What has happened to radio since it was so abruptly shunted aside by the onslaught of television back in 1946? Basically, as far as circuitry is concerned, very little. However, there have been some significant changes made in components and it may not be amiss at this time to examine these in some detail.

The first item to strike you upon examination of current sets is the change in tube types. Thus, where we used to find such tubes as a 12SA7 (converter), 12SK7 (r.f. and i.f.), 12SQ7 (detector, a.v.c., and 1st audio), 50L6 (output), and 35Z5 (power supply), we now find such miniature replacements as a 12BE6 (converter), 12BA6 (r.f. and i.f.), 12AT6 (detector, a.v.c., and 1st audio), 50C5 (output), and 35W4 (power supply). The miniature

tubes are more compact and generally possess slightly lower ratings than their predecessors; otherwise they are comparable to the tubes they have replaced.

Alternate tubes for some of those just mentioned include a 12BD6 for the i.f., and a 35C5 for the power output. The choice of the latter tube is frequently governed by what tubes have been used in the prior stages and what total voltage is required by their heaters in series. Thus, if we have a 12BE6, 12BA6, 12AT6, and 35W4, then the 50C5 will round out the combination with a total series heater requirement of 121 volts. On the other hand, if we desire to add a 12BA6 r.f. amplifier, then the total required heater voltage rises to 133 volts, which is far in excess of what is commercially available. Under these conditions, it is wiser to substitute a 35C5 for the 50C5

In battery receivers, the current tube line-up is as follows: 1U4 (r.f. and i.f. amplifiers), 1R5 (converter), 1U5 (detector, a.v.c., and 1st audio), and 3V4 (audio output). There are,

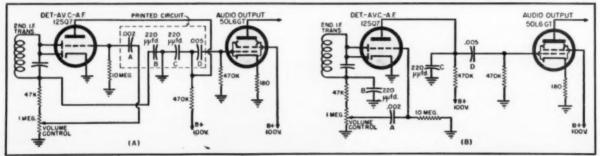
of course, other tubes which can be and occasionally are used, such as the 1V6 (mixer and oscillator), 1AH4 (i.f.), 1AJ5 (detector, a.v.c., and 1st audio) and 3S4 (output). However, most battery receivers utilize the first set of tubes noted.

A second important change in recent years has been the substitution of ferrite-rod antennas for the flat air-core loop antenna. This change, while principally made in portable and table-model sets has, to a limited extent, also been made in console receivers. The principal advantages of the ferrite-rod antennas stem from their reduced size (important primarily in portable sets) and their greater operating efficiency, the latter arising from the higher "Q" of these units.

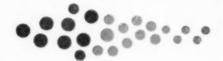
The flat air-core loop antenna has a fairly large area (approximately 20 square inches) and for optimum reception it must be oriented so that the ends are pointing toward the received signal. The most common position of this antenna in a portable receiver is within a hinged lid and when the set is to be operated, the lid is swung into an upright position away from the receiver cabinet.

When a ferrite-rod antenna, Fig. 6, is employed, it is generally mounted near the top of the receiver and does not have to be oriented for the best signal reception. Another feature of the ferrite-rod antenna is its ease of adjustment to obtain the correct inductance. This might be required in the manufacture of the set or when a ferrite-rod antenna is either being used to replace an air-core loop or simply another, defective ferrite unit. The adjustment is carried out by varying the position of the coil along the ferrite rod. A 10 per-cent change in inductance will be obtained by varying the coil position over the range of

Fig. 2. (A) Printed circuit consisting of four condensers, as used in an AM receiver. (B) Same circuit as shown in (A) rearranged to show where the four condensers would normally appear in the circuit if a printed circuit were not used.



### **AM RECEIVERS**



plus or minus one-quarter inch on the rod.

Incidentally, every one of the radio receivers now using an air-core loop can be converted to a ferrite-rod antenna. In many instances the greater "Q" of this unit will revitalize the set remarkably, improving not only the set sensitivity, but also its signal-tonoise ratio. Commercial units are available for less than a dollar at any parts jobber, and come complete with a mounting bracket having a predrilled hole for single fastener mounting. To obtain best results with these antennas, mount them as far as possible from any metallic surfaces or components. Ferrous metals will introduce more loss than nonferrous metals (such as aluminum, copper, and brass). After the unit is mounted in the set, the ferrite rod is moved back and forth until the best signal is ob-

#### **Printed Circuits**

One of the major electronic developments of World War II was the miniaturization of condensers and resistors through the use of printed circuits. Since printed circuit manufacturing techniques have been discussed in past issues of Radio & Television News, no explanation will be given here except to state that through the use of these circuits, it has been possible to simplify the manufacture of radio receivers.

The chief application of printed circuit components in radio sets has been in the network between the diode detector and the grid of the audio amplifier. See Figs. 3 and 5. The circuits are available with a variety of condenser and resistor values and with a number of components. For example, one of the simplest printed circuits in use replaces the two bypass condensers and series resistor in the load circuit of the diode detector. See Fig. 4. The printed circuit has three wires: one goes to ground while the other two are connected between the volume control and the bottom of the secondary winding of the output i.f. transformer. The circuit is symmetrical, and once the ground wire is established, either one of the two remaining wires may be connected to the volume control. The remaining wire is then attached to the i.f. transformer.

There is, of course, no limit to the complexity of these printed circuits and they may contain as many condensers and/or resistors as any par-

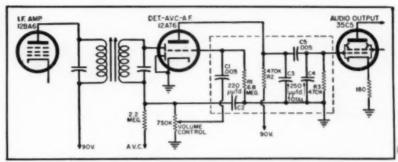


Fig. 3. In this partial schematic, a single printed circuit unit replaces five condensers and three resistors in the audio amplifier stages of set.

ticular application requires. Thus, in Fig. 2A, the printed circuit unit contains four condensers ranging in value from 220  $\mu\mu fd$ . to .005  $\mu fd$ . The first condenser, .002  $\mu fd$ ., serves to couple the volume control to the grid of the 1st audio amplifier. The second condenser, 220  $\mu\mu fd$ , bypasses the i.f. voltage around the detector load resistors. The third condenser, another 220  $\mu\mu fd$ . unit, serves in a similar capacity at the plate of the audio amplifier. The fourth and final condenser, .005  $\mu fd$ ., couples the audio signal from the plate of the 12SQ7 to the grid of the 501.6.

When the condensers are arranged as shown in Fig. 2A (in order to bring out the fact that they are all contained within the same printed circuit), their position in the receiver tends to be obscured. A rearrangement of the circuit to the form shown in Fig. 2B makes their individual purposes more evident.

A printed circuit containing five condensers and three resistors is illustrated in Fig. 3. C<sub>1</sub> couples the volume control to the audio amplifier; C2 is an i.f. bypass for the diode load circuit;  $C_3$  and  $C_4$  are similar i.f. bypass units for the plate circuit of the audio amplifier and the grid circuit of the audio output stage; Cs couples the audio voltage from the audio amplifier to the audio output. In the resistor section there is  $R_0$ , the grid resistor for the audio amplifier,  $R_2$ , the plate resistor of this stage, and  $R_3$ , the grid resistor of the following audio output stage. For what would be eight parts requiring sixteen leads to be soldered, we now have only one small component with seven leads. The savings under such an arrangement are obvious, and all this without any impairment of operation.

There are many other configurations that these printed circuits can take,

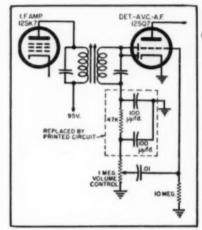


Fig. 4. Partial diagram of an AM receiver showing the components that can be replaced by a printed circuit.



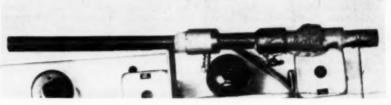
Fig. 5. The printed circuit used here has several resistors and condensers.

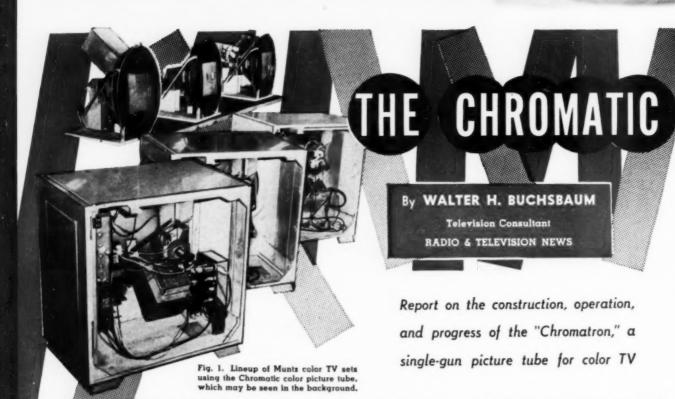
but those discussed are representative.

#### Printed Wiring

Another form of printed circuitry is the printed wiring which has recently been adapted to midget AM receivers, (Continued on page 181)

Fig. 6. A ferrite-rod antenna as installed on a midget radio receiver chassis,





HTH the inauguration of color TV received manufacturing, the problem of color picture tubes is again receiving much attention. RADIO & TELEVISION NEWS reported some time ago on the tri-color tube both as developed by RCA and as simplified by CBS-Hytron. Now it is possible to give some of the details concerning another type of color picture tube. This latter type, based on the ideas of Dr. E. O. Lawrence of the University of California was publicized as being a "simple" and inexpensive rival of the RCA tricolor tube. The actual development work on the tube and associated cir-Luits was taken over by Chromatic Television Laboratories, Inc., a subsidiary of Paramount Inc. The tube described here is not necessarily the final design. Further improvements and changes are currently under development.

The current model of this color picture tube has been named the "Chromatron" and a complete 22-inch unit is shown in Fig. 1. The neck and flared portion of the tube are essentially the same as for other metal envelope picture tubes, but the cone is made in two parts to permit separate assembly of the color screen. Although the "Chromatron" is a round picture tube, the color structure is rectangular and occupies less than the full screen space. Picture width of the tube shown is 16 inches; the remaining screen space is taken up by the frame and mounting flanges required for the color structure. Fig. 2 shows the color structure in its frame before being assembled into the complete "Chromatron." In the manner of assembly this is very similar to the RCA tri-color tube which also contains a separate color structure, frame, and flanges. While the RCA system employs three electron guns, the "Chromatron" uses only a single gun, but it would be possible to use three guns.

The deflection components used for the "Chromatron" are essentially the same as used for black-and-white picture tubes. This is a considerable ad-

Editor's Note: Although, to date, most manufacturers of color TV receivers have designed their color TV sets for use with the 3-gun color tube, as produced by RCA, CBS-Hytron, and others, a large segment of the industry is investigating the possibility of using a single-gun tube such as described in this article. This tube is based upon the invention of Dr. E. O. Laurence, and the development work of the Chromatic Television Laboratories. Engineers, manufacturers, and all others concerned in the color television industry are divided on which type of tube will predominate in the future. Each has its advantages and disadvantages.

sion industry are divided on which type of tube will predominate in the luture. Each has its advantages and disadvantages. Which tube will be more popular? This depends upon which tube will result in a more simplified circuit, lower over-all set production cost, lower picture tube cost, and which tube will give the better picture. Although there is no reason welboth the 3-gun tube and the single-gun tube cannot live side-by-side, in the final analysis, the public will decide as to which will be more popular.

vantage over the RCA design which requires complex deflection yokes, a purity coil, and convergence and centering adjustments. The simplification at the neck of the tube is possible in the "Chromatron" because the complete color switching section is part of the color screen structure.

The RCA tri-color tube has a screen consisting of small dots of colored phosphors each of which lights up either in red, green, or blue. These

color dots are arranged in the correct sequence and the colored picture is the composite of the amount of light coming from a large number of dots.

The "Chromatron" uses lines of colored phosphor instead of dots and a special wire screen behind the phosphor strips makes the electron beam dance back and forth between the color strips to produce, effectively, a series of color dots. Fig. 4 shows the principle of the "Chromatron" color structure. A number of vertical strips are laid out, each containing a colored phosphor. The color sequence is arranged so that a green strip falls between each red and blue one. Behind the phosphor is a fine wire grid, so spaced that an electron beam passing between two wires will hit the green phosphor if there is no voltage between the wires.

The phosphor screen is aluminum backed, just as in some types of blackand-white picture tubes, and the aluminum backing is connected to a terminal outside the tube. If a voltage is applied between the two wire grids and the aluminum backing, a series of electron lenses will be set up between the wires and the screen. These lenses help to focus the electron beam so that a sharp spot is obtained on the screen. Although the focusing produced by these lenses is not as effective as the focusing coil or electrostatic focus element back in the electron gun, this "post deflection focus" (PDF) system has a considerable effect on the size of the spot. Because the acceleration of the electrons in the beam is so high near the screen, the focusing potential required is much greater than at the electron gun.

# COLOR) PICTURE TUBE In addition to the focusing potential, another voltage can be applied between the set of wires located behind the red and the blue phosphor strips. Depending on the red airly and magning the set of the red and the polarity and magning the red airly area.

Fig. 2. Rectangular screen of the

"Chromatron" showing the frame which

holds the color grid wires in place.

another voltage can be applied between the set of wires located behind the red and the blue phosphor strips. Depending on the polarity and magnitude of this voltage, the electron beam will be deflected from striking the green strips and hit the red or blue strips.

The color of the spot is therefore determined by the instantaneous voltage between the two sets of wire grids. while the size of the spot is determined by the d.c. voltage between the aluminum backing and the electrical center of the two wire grids. This is similar to the application of centering voltage in an electrostatic deflection cathoderay tube. In the simplified sketch of Fig. 5, the condition is illustrated where the electron beam hits a green strip because no potential exists between the red and blue wire grids. If a positive voltage is applied to the red wire grid, for example, the electron beam would be deflected slightly more to the left and hit a red phosphor strip.

In addition to the deflecting action of the two wire grids, the electron beam is also moved by the vertical and horizontal deflection coils located around the neck of the tube. It should be understood that the action of the two wire grids is on the order of a minute jiggling motion, superimposed on the horizontal and vertical sweep movement of the electron beam. The colored phosphor strips, the wires, and the spacing between the wires are all so small that from the standard viewing distance individual colors are not discernible.

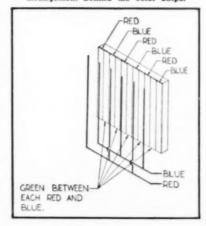
For operation under the NTSC standards for all electronic color TV, the color switching rate for the wire grids is 3.58 mc., the frequency of the color subcarrier. Rigid standards are needed to maintain the phase relationship between the three color components since it is this relationship which delivers the color or chromaticity information.

To switch at this rate raises some problems when we consider that the wire grids contain considerable capacity and require quite some power to move the electron beam sufficiently. The d.c. voltage on the wires for focusing is on the order of 5000 volts and

the a.c. switching signal must, accordingly, be strong, usually about 500 volts. In one practical demonstration the driving power was about 25 watts. To increase the efficiency of the system somewhat an external inductance was used to resonate the approximately  $1200~\mu\mu fd$ . capacity due to the wire grids.

The problem of driving the wire grids, however, is being solved by new driving methods and a modification in the design of the "Chromatron." One approach is to move the grid wires further away from the screen and, thus, reduce the capacity. This would help to reduce the required driving power considerably. In addition to the switching circuits it is also necessary to key the cathode or control grid of the electron gun so that only the red picture information or brightness level exists during the instant that the electron beam hits the red phosphor, and so on for the other colors. To accomplish this, the output of the three video

Fig. 4. Representation of the "Chromatron" phosphor screen showing the grid grangement behind the color strips.



amplifiers are switched, each delivering its signal, in turn, to the picture tube.

A block diagram of the circuitry needed to utilize the "Chromatron" (Continued on page 156)

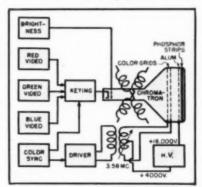
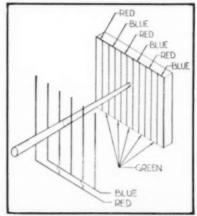
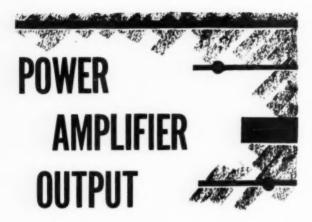


Fig. 3. Simplified block diagram of the circuits required with the "Chromatron."

Fig. 5. Electron beam excites green phosphor strip when no deflecting voltage is fed to the blue and red grid wires.



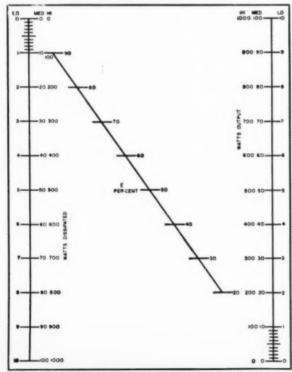


By JOSEPH F. SODARO, WEZRT

Simple nomograph for determining power output versus efficiency for tubes of a specified plate dissipation rating.

POWER amplifier tubes are rated by maximum allowable plate dissipation. By this system of rating, the 100 watter is a tube which will dissipate 100 watts at the plate. However, this tube may generate from 25 to 500 watts in the circuit. This power output difference depends upon the circuit efficiency. Efficiency, in turn, depends upon the amplifier class and operation. For example, the class C amplifier is more efficient than the class A amplifier. Also, a class C amplifier with adequate

Fig. 1. Dissipation vs output calculator. See text on its use.



excitation and plate voltage has higher efficiency and output than one with inadequate excitation or plate voltage. "Watts output" is an important figure to the amateur. It is the purpose of this article to present a simple, rapid method of estimating output in terms of allowable plate dissipation. Such an estimate is made possible by the calculator shown in Fig. 1.

The dissipation-output calculator of Fig. 1 is used by simply placing a straightedge across the scales through an anticipated or known amplifier class or efficiency. The class C amplifier is at the top of the group with an efficiency range of 60 to 80 per-cent. Sometimes 85 to 90 percent is given as an upper limit. Class B amplifiers have efficiencies from 50 to 60, class AB from 40 to 50, and class A from 20 to 35 per-cent. The class B linear amplifier has an average efficiency of about 30 per-cent, reaching 50 to 65 per-cent at full output. The high-efficiency Doherty amplifier has an average figure of 60 per-cent.

The power output calculator has been designed for estimating maximum output when maximum allowable plate dissipation and efficiency are known. This calculator can be used during transmitter planning to determine the power output to be expected when a certain tube is operated in a certain class of amplifier. The chart can also be used to estimate dissipation power for values of efficiency and output. Another application of this graph is the determination of circuit efficiency when input and dissipation powers are known. In general the nomograph can be entered on any two scales and an answer read on the third scale.

On the left side are the power dissipation scales. On the right side are the power output scales. In order to meet all amateur transmitter power requirements, these scales have several ranges. Thus the low power range (LO) runs from zero to 10 watts, medium (MED) to 100 watts, and high (HI) to 1000 watts. It is only necessary to remember to read both dissipation and output on scales of the same range. Thus, use LO with LO, MED with MED, and HI with HI.

All scales are linear. Thus, the midpoint between two scale values is the midscale value. Notice that while the power dissipation scale increases downward, both the power output and efficiency scales increase upward. The first major division on both outer scales is subdivided into ten smaller divisions. Each of these is one unit. Thus, the fourth division from zero is 0.4 on "LO," 4 on "MED," and 40 on "HI."

#### Using the Calculator

To use the calculator simply locate values on two scales, place a straightedge such as a plastic rule through these values, and read the answer where the rule intersects the other scale. A straight line can be drawn through the three points if desired. A piece of black thread is an excellent nomograph indicator.

As an example, assume that a tube capable of dissipating 20 watts is on hand and we wish to know what outputs can be expected from this tube when used in a radio-frequency power amplifier. Since this would be a class C amplifier we place the straightedge indicator across 20 on the "MED" dissipation scale and 60 per-cent on the "E" scale and read an output (Continued on page 121)

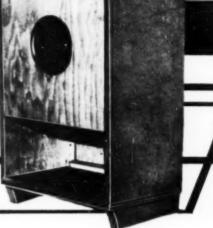
Table 1. Dissipation multiplying factors for rapidly estimating the power output of a given tube. Their use is covered in text.

EFFICI	MULTIPLYING		
FRACTION	PER-CENT	FACTOR	
1/4	25	3/9	
1/3	33.3	1/2	
1/2	50	1	
2/3	66.8	2	
3/4	75	3	
16	80	4	
5,4	83.4	5	
67	85.7	6	
7/8	87.5	7	
86	88.9	8	
910	90	9	

# The 'DIFFUSICONE - 8' **ENCLOSURE**

ABRAHAM B. COHEN University Loudspeakers, Inc.

Over-all view of enclosure for the University "Diffusicone-8", shown without finish.



Designed for an 8-inch speaker, this cabinet received considerable attention at last year's N.Y. Audic Fair.

PTIMUM performance of a loudspeaker is obtained when it is mounted in the proper enclosure. The enclosure and the loudspeaker must be matched to each other. A 6inch speaker doesn't require a seven cubic foot cabinet, nor will a two cubic foot cabinet suffice for a 15-inch woofer. The University cabinet for the "Diffusicone-8" was designed to provide the proper load match for this speaker. Since this speaker is a highefficiency, extended-range radiator, it requires a cabinet that will:

(a) allow its extended high frequencies to spread into the room without obstructions due to bends or folds in the cabinet;

(b) do justice to the high-level, lowfrequency output of which the speaker is capable; and

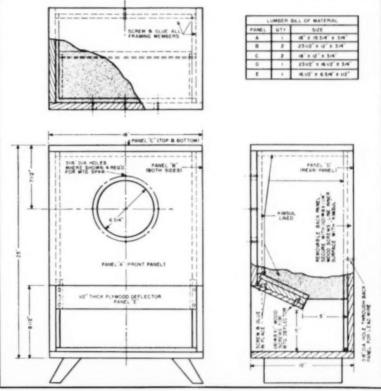
(c) be modest in size compatible with the performance requirements of the "Diffusicone-8"

Requirement (a), calling for an unobstructed path for the high frequencies, makes it mandatory that the enclosure and the speaker constitute a "direct radiator" combination, rather than a horn type. The final design of this enclosure resulted in essentially a bass reflex type of cabinet with the important addition of a horn load applied to the port of the enclosure. Thus, what looks like an exceptionally large port for a bass-reflex cabinet of this size is actually the mouth of the horn which feeds from the proper size port located at the rear bottom of the enclosure. The addition of the horn to the port permits smoother low frequency radiation than is possible from a simple port aperture. This condition holds because the efficiency of radiation of low frequencies rises as the size of the radiating opening becomes larger. Thus, since the mouth of the horn is more compatible, dimensionally, with the wave length of the low frequencies than is the smaller sized port, the horn adds a considerable measure of improvement to the performance of the bass reflex cabinet.

Inasmuch as this horn mouth lies at the bottom of the cabinet structure. the floor of the room acts as a natural extension of the horn walls which effect still further aids the low-frequency efficiency. The relatively small size of the enclosure allows it to lie flat against a room wall or in the corner. Due to the high efficiency of the "Diffusicone-8," the sound pressures developed within the enclosure for the lower frequencies require that the cabinet be constructed of heavy rigid

(Continued on page 150)

Mechanical details of cabinet construction. Although any 8-inch speaker can be used, its design and performance characteristics are based on the use of the University "Diffusicone-8" speaker. The cabinet is simple to build and is, fundamentally, a bass reflex cabinet with a horn flare. The entire upper section of the cabinet should be Kimsul lined. All inside corners are re-inforced by using  $\frac{1}{2}$ " square wood strips glued and screwed to the sides of the cabinet. Dimensions for the legs are not given and can be designed to suit the builder or omitted.





#### A profitable scource of service income is available to the service technician with some mechanical aptitude.

THE versatility and popularity of record changers presents a challenge and a new responsibility to the electronic service technician. In addition to thinking in electronic terms, he must think in terms of gears, cams, motors, and mechanical devices, so he can meet successfully the service requirements for a television-radio-phonograph combination.

Fortunately, to master the servicing of record changers does not call for learning the theory of mechanics. If the service technician can learn to focus his attention on the particular section that is giving trouble, refrain from trying to make a diagnosis by observing the mechanism as a whole, and exercise patience, he will be able to solve most of the problems that face him.

To most people, most record changers look alike, and so there is a natural assumption that they are alike and operate the same way. This is an erroneous impression. Every record changer has a motor, a tone arm, a spindle, and its function is to play records. However, in spite of all this apparent similarity, the working parts are different and each record changer has its own particular set of problems.

Many record changers, although made by the same company, appear under different brand names, so the ones discussed here have been selected because they represent different types of units.

For a record changer to accomplish its task it must have the following sections:

- An indexing or tone arm set-down assembly
- 2. A motor and speed reduction system
- A trip and reject system to start the change cycle,
- 4. A record drop mechanism to furnish a new record.

Regardless of the brand of record changer, it will have to index (set the tone arm to the proper start position) correctly for 7", 10", and 12" records. How is this accomplished? The Admiral RC600 uses a set-down index assembly, shown in Fig. 1, containing slots for each size record.

The tone arm mechanism is made to fall into the proper slot by a control finger extending above the changer base which feels the edge of the record played. Failure to index correctly must be attributed to one of these two parts. For instance, the control finger may be bent so that it does not feel the edge of the record, or there may be an obstruction in the slot in which the tone arm shaft rides as it lets the tone arm down to the record.

The V-M 950 record changer also uses a control finger rising above the changer pan to feel the size of the record to be played. See Fig. 3. The finger does not control the set-down index assembly by feeling the edge of a record, but rather by the height to which it travels. Twelve inch records have a separate selector to control the index assembly. The actual setting down of the tone arm on the record is accomplished by the tone arm shaft sliding down the inclined angle of a cam. If index trouble in this record changer is not solved by the adjustment screw under the tone arm, it may be because the control finger is bent so that it rises too high above the changer base.

In the Motorola RC36 record changer the location of the index position is determined by the manual movement of the record support shelf. The record support shelf (see Fig. 2) is geared to the index set-down cam. This set-down cam is positioned correctly so that when the tone arm assembly is moved inward, it will stop at the proper record size. The actual setting down of the tone arm on the record is accomplished by the tone arm shaft riding down the inclined section of the cam assembly.

Failure to index correctly, if only by a narrow margin, may be corrected by the index adjustment screw located at the inside rear of the tone arm. More complex servicing information on this problem will be given in a future article.

#### Motor and Speed System

The modern motor is electronically balanced, has powdered metal bearings, requires very little service, and is a mighty sturdy and reliable piece of equipment. When the record changer is ready to be discarded because it is obsolete or worn out, the motor is still going strong.

The need for service arises in the linkage between the motor and the turntable, where the 1750 rpm of the motor is reduced to 78, 33½, and 45 rpm for the turntable. The turntable not only must rotate accurately, but must also supply power to the rest of the mechanism. Different methods are used.

For example, the Zenith S14028 record changer has the motor shaft contacting a drive wheel lying horizontally that furnishes the power (see Fig. 4). An idler wheel riding vertically between the turntable bottom and the drive wheel provides the friction necessary to turn the turntable. The speed of the turntable is controlled by changing the position of the idler wheel on the drive wheel. When the idler wheel is moved inward, it will rotate more slowly. This is because the inside of the drive wheel moves more slowly than the outer edge.

In the RCA 960282 series, only one wheel between the motor shaft and turntable rim provides the friction to turn the turntable. Speed is controlled for the different rpm records by the motor shaft itself. The motor shaft is different from the ordinary pencil-like variety in that it has enlarged sections, similar to the shaft used by Philco and shown in Fig. 5. Moving the idler wheel to different places on the shaft controls the speed by the principle that the outside of the larger shaft moves more rapidly than the outside of the narrower shaft.

The method used in the Webcor 106



changer is that of an idler wheel furnishing the friction, but the turntable speed is changed by placing a pulley between the idler wheel and the motor shaft. The circumference of the pulley placed between the idler wheel and the motor shaft determines the turntable speed. Another type of speed reduction system using pulleys and a belt drive is shown in Fig. 6.

Service requirements differ with the type of speed reduction used. One principle, common to all, is that the turntable speed and power depend upon friction coupling between the motor shaft and the turntable. Naturally, any loss of friction means incorrect turntable speed and loss of power to pull the mechanism through its change cycle. This loss of friction can be due to oil or grease on the idler wheel, pulleys, or turntable rim. The spring that holds the idler wheel to the motor shaft, or, in the case of Webcor type units, the idler wheel to the pulley, may be weak. A worn idler wheel or pulley, or any binding of a pulley or idler wheel on the shaft on which it turns, also are possible causes of trouble. A small thing like removing the gloss from an idler wheel or pulley may solve the problem.

The most important single service on any type of speed reduction system is a good cleaning, preferably with alcohol.

#### Reject and Trip Section

In any automatic device, every part is essential. It is true that the smallest washer or nut can cause even a well designed machine to fail. The trip and reject system is the very heart of the record changer. Because it is so important to the operation of a record changer, it stands to reason that its function must be perfect. There is no room for error here, and here lies the greatest single cause for complaint.

The reject system performs two important jobs. The most important is the control of the playing cycle; i.e., the reject system must allow the record player to play through an entire record before beginning the change cycle. The second job of the reject system is to release power from the turntable to the main cam which, in turn, operates the change cycle. These two operations work together, and one is dependent upon the other.

The most important service for the trip and reject system is a good cleaning, just as in the speed reduction

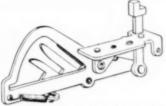


Fig. 1. Index assembly used in the Admiral RC600 automatic record changes.



Fig. 2. The indexing for different record sizes is controlled manually in Motorola record changer shown here.

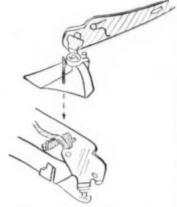


Fig. 3. Indexing system used in the V-M automatic record changer. The vertical finger on the tone arm support sets the slider on the indexing assembly below the turntable so that the tone arm moves to the proper start position for different record sizes.

system, for dirt and grease will cause malfunction.

Practically all changers use a velocity trip method which means that they take full advantage of the oscillating grooves in the center of the record. The reason this method is popular is because the trip and reject can be controlled irrespective of the type of record played, whether it has more or less than normal playing time.

Although the velocity trip and reject is common to all record changers, the principle and method vary with each manufacturer.

One RCA record changer has spiral

grooves on the turntable to operate the change cycle. Here, the trip causes a plunger to jump into the spiral and start the change cycle. A Zenith changer uses a solenoid that becomes activated by the trip and permits the change cycle to begin. A weighted cam in a Phileo model is released by the trip action and permits the record changing mechanism to operate.

Obviously, the repair required is dependent upon the type of reject mechanism. For instance, in the Zenith, first determine if the solenoid is being activated by the trip finger. If it is

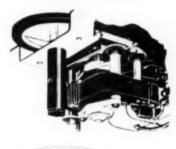
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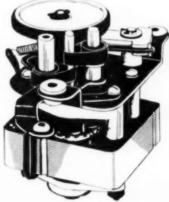
Fig. 4. A vertical idler wheel (not shown) rides on the upper face of the horizontal drive wheel in the Zenith speed system. The position of the idler wheel on the drive wheel determines final speed.



Fig. 5. The Philco motor and speed reduction system uses a single drive shaft working against another shaft with three different size pulleys for various speeds.

Fig. 6. Admiral and V-M speed reduction system using a set of pulleys with a belt drive from the motor armature shaft.





# The author's antenna for u.h.l. reception on channel 43.

# HOME-BUILT U.H.F. ANTENNAS

By ROBERT H. HAWKINS

Details on four collinear arrays for channels 14-30,31-47,48-64 and 65-83.

Antennas may be built in an evening.

THE licensing of many new TV stations in the u.h.f. range has brought with it many "growing pains" for the TV set owner. Some antennas work well in one area, others work better for another location. Should we use round lead-in wire or wire of the oval cross section? Many such questions arise as a community learns to live with its new u.h.f. station.

This article covers an easily-built

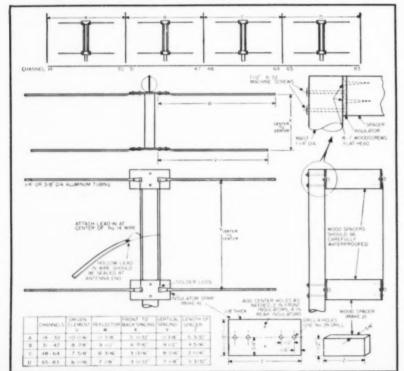
antenna that has helped improve reception for TV set owners who were about to conclude that their sets or converters just didn't work for u.h.f. reception. There is nothing new or original about the basic design used. It's a collinear array, the same design as used by amateur radio operators for many years. The only things that have been done to adapt this simple design for u.h.f. television use is to determine the proper element lengths and spacings and mount the antenna for horizontal polariza-

The antenna shown in the photograph is specially cut for channel 43, but, using the dimensions shown in the chart, antennas can be constructed which will cover the u.h.f. channels as indicated. Four antennas are listed and they are so spaced throughout the u.h.f. television spec-trum that they will give adequate coverage for the entire band. The antennas are broadbanded enough to cover more than the seventeen channels assigned to each of the antennas A, B, C, and D. Choose the one which comes closest to the channel of the u.h.f. station in your area and it should help you achieve reception equal to or better than that obtained by your neighbors. It's always a source of pride to say, "I built it myself," so here is how you can build yourself a good u.h.f. antenna in a single evening.

Constructing the antenna requires few tools, a small amount of material, and not much time. The elements can be made from ¼" alumi-num welding rod or ¾" diameter aluminum tubing. (Either size seems to work equally well; the larger diameter makes the antenna a little more broadbanded.) Cut them to length as shown in the diagram. four driven elements and four reflectors. Flatten one end of each element about 1" in from the end and drill two holes as shown, using a #29 drill. Make four insulator strips from fiber, or preferably polystyrene, as shown. Two wooden spacers are required to separate the driven elements from the reflectors. After two assemblies consisting of two driven elements and two reflectors each are

ents and two reflectors each (Continued on page 143)

Mechanical details for building receiving antenna for the u.h.f. television bands.



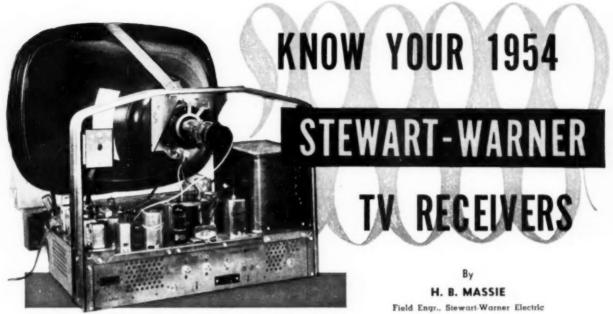


Fig. 1. Rear view of the Stewart-Warner 9340 series TV chassis.

Another complete analysis of a popular 1954 TV set including the schematic diagram and alignment data.

ALL THE 1954 Stewart-Warner television receivers incorporate the "Thunderbolt" chassis that will be used with 21-inch, 24-inch, and 27-inch picture tubes. There are two basic chassis: one incorporates a turret-type v.h.f. tuner which can be adapted to u.h.f. by inserting a set of strips in the tuner for the particular u.h.f. channel involved, the other utilizes an all-channel turret-type tuner and additional new circuitry. The latter chassis, the 9340 series, containing a 21-inch picture tube, will be discussed.

All the "Thunderbolt" chassis incorporate many new features which simplify servicing, such as the positioning of receiving tubes on the chassis to allow for easy replacement. (See Fig. 1.) Also, plug-type connections are used for the flyback transformer and deflection yoke so that they can be replaced without the use of a soldering iron or removing the chassis from the cabinet. A special-type chassis bracket is used which allows for easy removal of the chassis from the cabinet as well as allowing the chassis to be turned upside down for servicing. (See Fig. 2.)

#### Tuner

The all-channel turret-type tuner furnished with the 9340 series sets is of the latest design, and is capable of tuning all standard television channels in the v.h.f. and u.h.f. range from channels 2 to 83. It consists of two separate chassis joined together as a unit. The front section tunes the u.h.f. stations, channels 14 to 83, and incorporates two preselector stages, a 6AF4 or 6T4 tube as the oscillator, and a 1N82 crystal as the mixer. The rear section performs a dual function in that it tunes all the v.h.f. stations, and

operates as a 41-mc. i.f. amplifier when the receiver is tuned to any u.h.f. channel. It incorporates a 6BZ7 or 6BQ7A tube as a cascoded r.f. amplifier for v.h.f. operation and as a 41-mc. i.f. amplifier for u.h.f., and a 6U8 as the oscillator-mixer. In the u.h.f. position, the oscillator section of the 6U8 tube is rendered inoperative.

Fine tuning of both the v.h.f. and u.h.f. channels is performed by the same control. The shaft of the fine tuning control rotates two separate pieces of dielectric material simultaneously between two separate sets of condenser plates, one set connected to the u.h.f. and the other to the v.h.f. oscillator tank circuits. The front-

Fig. 2. The special chassis bracket on Stewart-Warner's TV sets makes removal from the cabinet very simple.



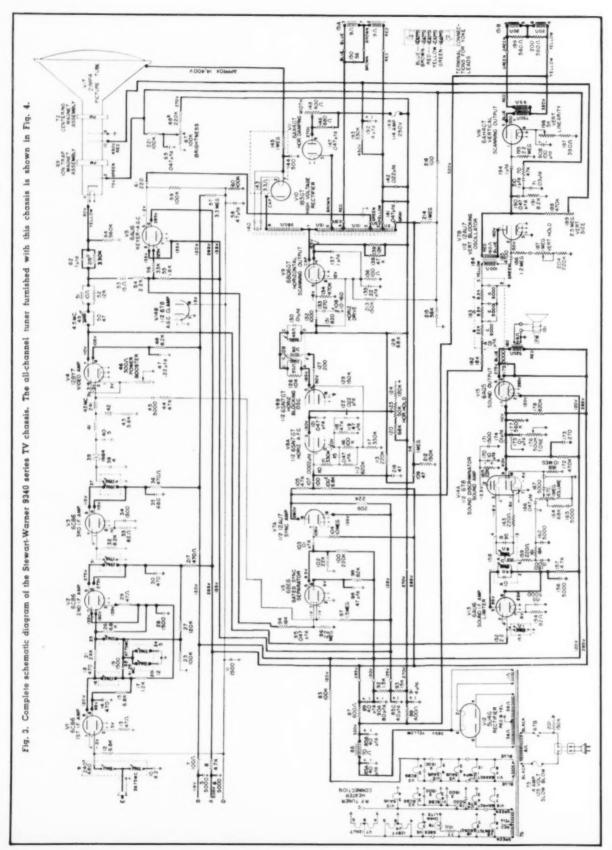
panel oscillator adjustment is merely a screw adjustment similar to that used in many v.h.f. turret-type tuners. The adjustment tool should be a non-metallic screwdriver at least 9 inches long, so it can make contact with the v.h.f. oscillator slug which is located in back of the u.h.f. section.

The selection of a u.h.f. channel is accomplished in a dual manner. Rotation of the u.h.f. turret, which is accomplished by turning the middle knob, sets into position a coil assembly that can be tuned through a range of 10 channels with the front knob. Eight different coil assemblies are used and they are easily removed for replacement. There are nine settings of the u.h.f. turret, one of which is blank, containing no coil assembly. For v.h.f. operation, the u.h.f. turret is placed in the blank position.

The u.h.f. signal entering the tuner is first fed through a high-pass filter, consisting of condensers 402A and 402B and inductances 403 and 404, which attenuates all frequencies below 470 mc. See Fig. 4. It is then coupled to the first preselector circuit, which consists of a coil connected between terminal "F" and a condenser plate.

From here the signal is coupled through condenser 406 to the second preselector stage which consists of a coil connected between terminal "H" and a condenser plate. One condenser plate is common to both preselector stages and is grounded through terminal "G." These preselector coils and

(Continued on page 62)



			VIDEO I.	F. ALIGNMENT		
STEP	SIGNAL G	ENERATOR CONNECT TO	OUTPUT	CONNECT TO	ADJUST	REMARKS
1	45 mc., 10 mc. sweep. 42 mc. and 45 mc. markers	Pin I of V Output of sweep gener- ator (loosely coupled)	Oscilloscope or and a V.T.V.M. through a 10,000-ohm resistor	Pin 2 of V <sub>4</sub>	Primary and second- ary of 3rd i.f. trans- former for maxi- mum, with even plateau between markers. Connect a detuning clip to pin 5 of V:	Short antenna terminals together. Sweep generator out put at detector should be I volt maximum. Place 1000 µµfd. condenser across oscilloscope terminals.
2	45 mc., 10 mc. sweep. 42 mc., 43.5 mc., and 44.9 mc. markers.	Pin l of V <sub>z</sub> through a 100-µµfd. condenser. Output of sweep gener- ator (loosely coupled)	Same as above	Same as above	Primary and second- ary of 2nd i.f. trans- former for maxi- mum—with even plateau between markers. 43.5 mc. marker in center.	Remove detuning clip. Connect negative terminal of 3-volt bias battery to a.g.c. line at point "D" (Fig. 3) on i.f. strip, positive side. to chassis.
3	41.25 mc. unmodulated	Pin 1 of V	Same as above	Same as above	Sound i.f. trap for minimum	Disconnect a.g.c. bias battery.
4	47.75 mc. unmodulated	Pin 1 of V	Same as above	Same as above	Adjacent sound i.f. trap for minimum	
5	45 mc., 10 mc. sweep. 42.5 mc. and 44.5 mc. markers	Pin 1 of V: Output of sweep gener- ator (loosely coupled)	Same as above	Same as above	2nd i.f. grid coil and lst i.f. plate coil for maximum with even plateau be- tween markers	Reconnect a.g.c. bia battery as in step 2.
6	39.75 mc. unmodulated	Top of raised tube shield on V	Same as above	Same as above	Adjacent picture i.f. trap for minimum	Disconnect a.g.c. bias battery.
7	45 mc., 10 mc. sweep	Top of raised tube shield on V <sub>13</sub>	Same as above	Same as above	lst i.f. grid coil and converter plate coil (458, see Fig. 5) for curve below:	Reconnect a.g.c. bia battery as in step 2
			SOUND	ALIGNMENT		
8	4.5 mc. unmodulated	Pin 2 of V <sub>ε</sub> through a 1000-μμfd. condenser	V.T.V.M.	Pin 11 of pic- ture tube through high- frequency probe or detec- tor network shown in Fig. 8	Sound trap, coil 49, for minimum	Set contrast control to maximum counter-clockwise. Remove one of 6CB6 i.f. tubes.
9	Same as above	Same as above	Same as above	Pin 2 of V <sub>14</sub> through a 10,000-ohm resistor, using negative meter lead. Positive lead to ground	Top of transformer 158 for maximum	Reinsert 6CB6 tube.
10	Same as above	Same as above	Same as above	Same as above	Bottom of trans- former 158 for maximum	
11	Same as above	Same as above	Same as above	Same as above	Transformer 153 for maximum	
12		Same as above		Junction of two series 68,000- ohm resistors from pin 2 of V <sub>14</sub> to ground, Positive meter	Top of transformer 158 for zero between a positive and a negative peak	68,000 ohm resistors are added to V <sub>in</sub> circuit for align- ment only.
	Stewart-Warner 93 ment, cut out the r. to an inoperative	340 TV chassis. Be f. oscillator by settir channel and placi- first two tuner dru	efore align- ig the tuner ing a piece	lead to junc- tion of resistor 161 and con- denser 162		

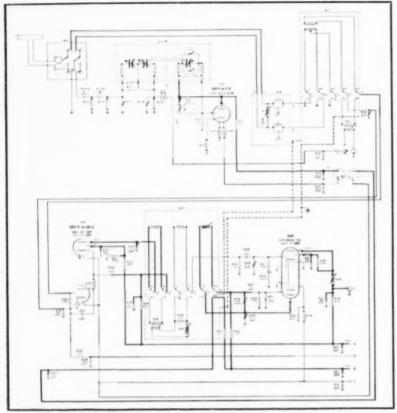


Fig. 4. Schematic diagram of the 82-channel turret tuner, furnished with the 9340 series Stewart-Warner TV chassis, shown set on a v.h.f. channel.

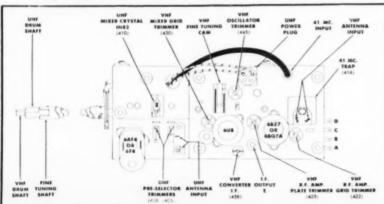
condenser plates are mounted on a single form and are tunable through a range of 10 channels. Selection of any one channel is effected by varying the amount of dielectric between the condenser plates. Additional tuning for alignment purposes is accomplished by adjusting condensers 405 and 408, and by either compressing or expanding the preselector coils.

A 6AF4 tube is operated as the u.h.f. oscillator, and its tank circuit consists of two condenser plates and a coil connected to each plate. These are mounted nels is approximately 2 to 3 mc.

Auxiliary fine tuning is accomplished by adjusting a metal slug between the oscillator-condenser plates on the coil form. On some tuners, auxiliary fine tuning is performed by a screw mounted on the face of the u.h.f. drum, which varies the capacity between the oscil-

on the same form as the preselector coils and form a complete coil assembly which is tunable through a range of 10 channels in the same way as the oscillator. In addition, the frequency range of fine tuning on all u.h.f. chan-

Fig. 5. Top view of the 82-channel turret tuner showing the major parts.



lator plate and ground. On other tuners this auxiliary fine tuning screw is mounted on the coil form. Adjustment of this screw changes the capacity between the oscillator condenser plates. As before, additional tuning, for alignment purposes only, can be accomplished by either compressing or expanding the oscillator coils.

The output of the oscillator is capacitively coupled to the second preselector coil. The coupling is in the form of a short piece of wire, one end of which is close to one of the oscillator condenser plates while the other end is close to the second preselector plate. Note that no physical contact is made with either plate.

The oscillator frequency and u.h.f. signal are then fed to a 1N82 crystal, 410, operating as a u.h.f. mixer. action produces the desired i.f. frequency of 41 mc, which is fed through a coaxial cable to the primary of transformer 421 which is mounted on a 41-mc. contact board. This board maintains electrical contact in the circuit of the 6BZ7 and 6U8 only when the tuner is set for u.h.f. operation, and is switched in by a cam action on the rear of the u.h.f. drum which, at the same time, breaks contact between the v.h.f. drum and its associated circuit. The secondary of transformer 421 is connected to the input circuit of the 6BZ7 tube, which is now operating as a 41-mc. amplifier. The 6BZ7 tube is a dual triode, and is connected in the circuit as a direct-coupled, grounded-grid amplifier. Transformer 438 couples the output from the plate (pin 1) of the 6BZ7 to the grid input of the pentode section of the 6U8 tube, which operates as a 41-mc. amplifier during u.h.f. operation. Transformers 421 and 438 and coil 440 are all mounted on the 41-mc. contact board. Note that in u.h.f. operation, terminal V3 on the 41-mc. contact board is left open, removing plate voltage from the triode section of the 6U8 tube, which makes this section of the tube inoperative. Signal output from the 6U8 is coupled through the plate coil, 458, to a coaxial socket on the tuner and then fed to the receiver's i.f. amplifiers.

For v.h.f. channel selection, the u.h.f. turret must be rotated until the blank setting is detented into position. This occurs when the middle knob shows the letters "v.h.f." in an upright position or when the flat of the middle shaft is in its uppermost position. With the drum in this position, there is no connection to the u.h.f. drum, which makes the u.h.f. oscillator inoperative. At this time the 41-mc, contact board is switched out of the circuit, and the v.h.f. drum is placed into operation, The desired v.h.f. channel selection is now brought about by turning the front knob which rotates the v.h.f. drum. This drum contains two sets of easily removable coil assemblies for each v.h.f. channel.

In v.h.f. operation, the antenna signal is first fed to a 41-mc, trap network, 416, which is tunable from the (Continued on page 176)



cardioid characteristics, for use in broadcast work.

OW, all the advantages of a pressure-operated type dynamic microphone, i.e., wider range response, greater sensitivity, and extreme ruggedness, are available in a cardioid microphone-the new Electro-Voice Model 666.8

Despite the overwhelming superiority of the dynamic type in all of the aforementioned categories, in the important field of unidirectional design. up to now engineers have not been able to use it for wide-range applications. This new development in the unidirectional field extends the highfrequency response, permits elimination of ribbons, and does not have a characteristic boominess in the high bass region, caused by the proximity effect, when used close to the sound source. In the field of microphone design, the successful application of the dynamic principle to a microphone of outstanding characteristics is a truly major advance

It is highly advantageous to have a unidirectional or cardioid pickup pattern in a microphone. In broadcast work it is generally desirable to exclude audience sounds and other noise not originating from the performers. It is also helpful if vocalists, with their respective microphones, can be placed near or in front of the orchestra with minimum orchestral pickup to confuse balance and sometimes override the singer. A directional microphone also prevents undue reverberation caused by reflected sound impinging from walls and reflective surfaces not a part of the performing area.

It is also necessary, in telecasting, to exclude the sounds caused by the movements of camera crews and noisy equipment. The preservation of an intimate quality in speech despite a fairly distant microphone position, out of the camera's range, can be achieved

only by a directional microphone. Further, rapid movement of a ribbon microphone can cause deformation or failure of the fragile ribbon. Increased ribbon sag can, in some cases, decrease the response resulting in non-uniform operation between microphones of the same model. Most essential, the development described herein presents adequate and uniform cardioid action throughout the entire range. In the region below 150 cps and above 4 kc., the improvement in the Model 666 is particularly noticeable and important because unwanted noise exists in the extreme bass region. Also, the ear is sensitive to the higher frequencies in speech, dolly squeaks, audience movements, and other extraneous noise to be found in the last two octaves.

Because of these new and stringent demands on microphone performance, it was obvious that the industry needed a lightweight, rugged microphone which could provide high and uniform front-to-back discrimination. Simplicity of design was also required to provide stable operation. Susceptibility to shock and wind noise had to be reduced and the size had to be small to eliminate shadows and make the microphone as unobtrusive as possible. A microphone which meets these requirements will be described.

· Patent Pending

Design and Operation

The Model 666 is 7½" long, 1%" at its largest diameter and 1" at its smallest diameter. The microphone is supplied with an integrated blast filter and magnetic shield and weighs only 11 ounces. Accessories for use with this model include a small, heavy cast stand and an inconspicuous shock mount for boom work.

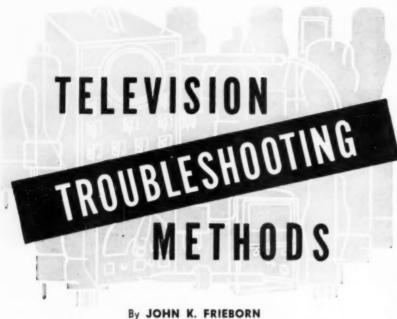
The output level of the microphone is -57 db below 1 milliwatt operating in a sound field of 10 dynes/ cm.2. Output impedances are available at 50, 150, and 250 ohms with a matching strap provided internally in the barrel of the unit.

The frequency response range, Fig. 2, is substantially uniform throughout the entire spectrum. The front-to-back signal discrimination is no less than 14 db at any frequency and averages 25 db throughout the spectrum in the back hemisphere.

The shape of the microphone, Fig. 1, is the result of fundamental functionality. The two tubes extending from the rear of the head cavity include sound entrances. These sound entrances, in combination with the openings directly behind the diaphragm, form part of three separate acoustic paths, all of different lengths. Each path is carefully calculated to pass sound over only that part of the spec-

(Continued on page 150)

Fig. 2. Frequency response of the Model 666. See text for discussion of response.



How systematic is your troubleshooting? Review the techniques described here for better TV servicing.

trying to outthink an *Ultravision* Model 2020 with a purple shamrock on the rear chassis apron and does it show people with short legs and long heads? Replace the vertical amplifier tube and/or  $C_{20}$ ."

This service hint may be valuable to you unless the only *Ultravision* Model 2020 that ever tried to get the best of you had a *green* shamrock and showed people with long legs and flat heads.

You say you want something that you can use a bit more often? How about this? "If the sound produced by a given receiver is all right, but there is something wrong with the picture, then the trouble is in one of the parts of the receiver which affect the picture but not the sound."

Too general, you say, and it doesn't tell you what to do? That isn't the half of it; sometimes such "obvious" statements are, from a practical point of view, not even true and television receiver troubles are not where they should be.

Both of the types of information mentioned do have their uses, of course. Sometimes the specific cure does refer to the receiver and trouble you have—or it can be applied to another receiver if you know enough to make the necessary changes. As for the general suggestions, they may be all you have to start with. Of course, going beyond them does require you to know how they apply to the particular receiver with which you are dealing.

Fortunately, there are many other

methods known to service technicians which can be used to find many different troubles in almost any type of receiver; this article will describe some of them.

Most—if not all—of the available techniques for finding troubles in television receivers can be divided into three types: 1. interpreting symptoms and tracing the functioning of the receiver to localize the trouble logically; 2. checking for particular faults which are known to occur frequently; and 3. checking components and adjustments which are easy to check.

Logical tracing of the receiver's functioning begins, of course, with observation of the symptoms. First, though, have the set-owner turn the set on, adjust it, and show you what is wrong with it. The fault may be in his (or her) methods. This also will avoid looking for the wrong trouble.

#### Sound Section

With one exception, the sound-producing functions of a television receiver are practically identical with those of an FM receiver. In addition, a TV receiver must separate the video signal from the sound. When it does not do so completely, we have the well-known video buzz, one of the most annoying troubles to the set-owner and often one of the hardest for the service technician to find. Actual direct function-tracing in this case is difficult. The best approach is to check each point in the circuit where the fault could be, since there are not very many of them.

First, check the sound i.f. tuned cir-

cuits by adjusting them to reduce the buzz. If no improvement is produced by manipulating a particular trimmer, return it to its original position. Second, in an intercarrier receiver, check the video i.f. tuned circuits which are intended to reduce the amplitude of the sound signal entering the video detector. (This requires specific knowledge of the receiver's i.f. alignment.) Third, also in an intercarrier receiver, if the sound is separated from the video signal after one or more stages of video (not video i.f.) amplification, check on the possibility of cross modulation in a video stage because of a weak tube, improper bias, or overloading. Fourth, in any receiver, if the buzz is most noticeable with a strong signal, check the possibility that the mixer tube is drawing grid current, thus offering a varying load which frequency modulates the oscillator. The cure is either to reduce the signal input to the mixer or rewire the circuit to apply a.g.c. bias to its grid. If nothing suggested here does any good, the service technician may console himselfthough not his customer-with the thought that many intercarrier receivers of a couple of years ago had a buzz "built-in." The seat of the trouble was a distorting video stage as mentioned in the third suggestion. The cure requires redesign of the receiver, with the sound take-off immediately after the video detector and an additional sound i.f. stage.

#### Picture Section

In dealing with picture faults, the first step is the hardest: determining exactly which function is not correct. We must recall just what functions are required to produce the picture and examine each one separately. Those functions are: 1. light production, 2. focusing, 3. beam modulation, 4. vertical deflection, 5. horizontal deflection, 6. vertical synchronizing, and 7. horizontal synchronizing.

If the screen is dark or less bright than normal, the trouble is one of the following: heater voltage low or absent, cathode worn, ion trap magnet misadjusted, improper electrode voltage (grid bias and first-anode potentials are possibilities as well as the high voltage), phosphor worn, or other picture tube fault such as loose connection in base.

To check focusing note the width of the scanning lines. They should be as narrow as possible and well-separated from each other, over as much of the area of the screen as possible. Inadequate focusing may be due to improper adjustment of ion trap magnet, improper position of focus coil or magnet, or (in case of focus coil) faulty focus-control, current- or voltage-di-

viding network.

Beam-modulation faults, indicating improper video signal delivered to the picture tube grid-cathode circuit, are of many different types. "Snow," interference, "ringing," and lack of signal are the principal defects.

"Snow" usually is said to be caused

by a weak signal, but it would be more accurate to say that a weak signal does not override the "snow," which is always present but not visible in the presence of a strong signal. If the signal actually is not weak, the fault may be in the antenna system (insufficient gain, loose connection), or in the r.f. section of the receiver (loose connections, corroded contacts, weak tubes, improper voltages).

A regular pattern superimposed upon the picture indicates an interfering signal. Some clue to the source usually can be obtained by computing the frequency of the interference. If horizontal bars are produced, multiply onehalf the number of bars (dark and light), from the top of the picture to the bottom, by 60 cycles. In Fig. 1, two bars are present, so that interference is due to a 60-cycle signal (in this case, hum in the video amplifier or picturetube circuit). If the bars are vertical or diagonal, multiply one-half the number of bars by 15,750 cycles. The pattern shown in Fig. 2 contains about 120 bars, allowing for the entire width of the screen (Fig. 2 shows only part of the screen) and the horizontal retrace, and the interfering signal is about 1 mc. This effect could be produced either by a 1-mc. signal injected into the video amplifier, or a signal 1 mc. more or less than the video carrier frequency injected into the r.f. or video i.f. sections.

The pattern in Fig. 5 is not caused by an external interfering signal. Note that the bars are not straight and do not cover the entire screen. This effect is caused by "ringing"—oscillation, possibly in the video amplifier, but usually in the video i.f.

A useful technique for diagnosis of faults in the receiver's response to video signals is to draw (or imagine that you have drawn) a picture of the waveshape which would produce a portion of one line as it appears on the screen and as it should appear. (See Fig. 3.) Poor response to either high or low frequencies may be due to misalignment of the video i.f. amplifier or to faulty components in the video amplifier. Poor low-frequency response can be further localized by noticing the effect of manipulating the fine tuning control. If no setting of the control gives adequate low-frequency response, the fault is in the video amplifier. Poor high-frequency response cannot be localized so easily, but usually it is due to i.f. misalignment.

One case of variation in light on the screen is not caused by a grid-cathode signal in the picture-tube circuit at all. (See Fig. 6.) This is due to "ringing" in the horizontal deflection circuit, causing each line to be folded back upon itself. (See Fig. 4.)

Most vertical and horizontal deflection faults, causing insufficient size or nonlinearity, produce easily recognizable effects on the picture. On the other hand, it may be difficult to tell whether certain other faults are in the deflection section or in the synchronizing section of the receiver. Faults in



Fig. 1. Pattern produced on TV screen by 60-cycle hum interference in video.

either one may cause vertical "rolling" or horizontal "tearing." The test is to adjust the hold control very carefully and note the effect. If the picture can be brought into proper synchronization, even momentarily, without going to either extreme of the control's range, the frequency-controlling parts of the deflection circuit are OK and the trouble is in the synchronizing circuits.

#### Checking the Stage

When a fault has been isolated to a section of the receiver, the faulty stage can be found by signal tracing or signal injection. The most adequate signal tracer for the deflection and synchronizing stages—and even for the video amplifier—is an oscilloscope. For other stages, suitable voltmeters and signal generators can be used. At two points in the receiver, the faulty stage cannot be found by simple stage-to-stage tracing: the mixer and oscillator, and the horizontal a.f.c. circuit. In both cases, two inputs are required to produce the proper single output.

Oscillation of the oscillator can be verified by measuring the developed grid bias in receivers where a test point is provided. If the measurement is made without the benefit of a special test point, precautions must be taken so that the loading effect of the meter will not disturb the functioning of the oscillator. Such a measurement in any case tells nothing about the frequency of oscillation. The frequency may be checked with a frequency meter if available or the functioning of the receiver may be observed using a substitute signal from a signal generator.

The faulty component within a stage

Fig. 5. "Ringing" interference is caused by oscillation in video i.f. amplifier.





Fig. 2. One-megacycle interference produces this beat pattern on picture tube.

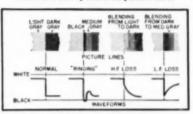


Fig. 3. Matching the appearance of a picture line on the CRT with the type of signal waveform that produces it.

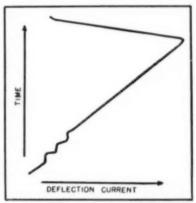
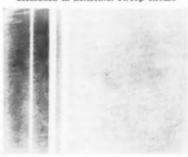


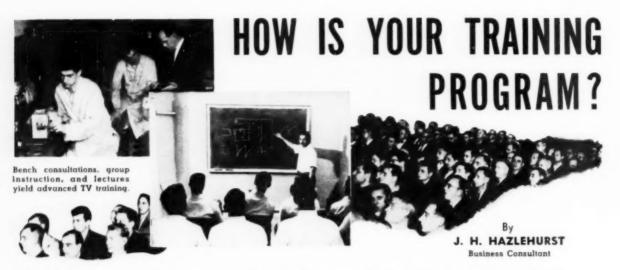
Fig. 4. Horizontal deflection waveform producing vertical lines as in Fig. 6.

can be found by the direct and indirect methods common in troubleshooting: tube replacement, voltage and resistance measurements, condenser bridging, etc.

The systematic method described for localizing the trouble to a section, to a stage, then to a component, sounds (Continued on page 149)

Fig. 6. Vertical white lines caused by oscillation in horizontal sweep circuit.





Do you have an efficient training program for the NY owner of a service shop, if he keeps records on employee "turnover," is aware of the "fluidity" of radio and TV service technicians in your shop? If not, you stand a chance of losing your key men. The correspondence and home days.

his shop force, particularly his field men. In a general way, he is also aware of the fact that the staff needs training. In some of the larger shops time may be set aside during which training sessions are held. It is the exceptional owner, however, who has any realization of how much such training periods cost him or, alternately, how much the lack of such formal training costs him in lost time and inefficient servicing.

Unfortunately this is not a problem that the shop owner can take or leave alone. In this respect it is like public relations. The shop owner cannot decide whether he will or won't have a public relations program. He has one. His only decision is whether it will be good or bad. The same is true of training. Whether or not it is recognized. every shop owner has a training program. Any owner or shop foreman who is called to confer with a bench man on a problem set is spending time and money in training. When several men are in a discussion, during working hours, over a "dog," the shop owner has just spent money in training. When a repaired set bounces, some of the money spent in making it good can be charged to training if that is any satisfaction to the shop owner. If you are in the radio and TV servicing business, you are also in the training business whether you know it or not and whether you want to be or not.

If the training challenge is to be met properly, it must be met on two fronts the industry front and the individual front. Let's consider the industry side first. Perhaps few busy people in the service game realize the extent to which training programs have grown within the electronics industry in general. Consider the phenomenal growth of the organizations supplying service information. Actually, these are "training aids" and the demand for them and the "how-to-doit" books has increased to an unbelievable extent since the old radio

study schools have increased in size and number. Schools with residence courses are still jammed with students. Every manufacturer has field men who put on training meetings covering everything from antennas to test instruments. Most of these are excellent, but the overlap in material is very great. If a shop owner took on all these programs, his men would never be at the bench or out making home calls. It is no wonder, then, that the practical shop man looks with a chilly eve on the eager beaver who wants him to have his men attend a hot meeting, say, by a tube manufac-

The fact is that the training aspect of the servicing field is in the same state as the manufacturing branch of the industry in the days when some wanted to scan from left to right and some from right to left, and everyone had his own notion of the proper number of lines per frame and frames per second. The solution to that problem was the NTSC. It is my opinion that the solution to at least a great part of the current training rat race lies in an analogous mechanism for the service

Logically, this should be spearheaded by the national associations in the service industry. It is doubtful, though, if this is a practical answer at the present time owing to the fact that these associations do not have the full backing of the service shops of this country, nor do they have the funds to undertake such an enterprise. The greatest weakness of the servicing industry is that it has not yet developed the leadership necessary to make it an integrated segment of the industry that is both vocal and intelligently powerful. Certainly, the leadership is there somewhere, and in time it will

assert itself, but meanwhile, it is probably going to be up to the manufacturers to supply the needed unification and streamlining of the welter of training efforts now being made. While this may not be the manufacturer's responsibility, it would be to his advantage to do it. Many a manufacturer has discovered that while it is not his responsibility to do sales training at the retail level, it nevertheless pays off in increased profits.

Much has been said about service charges being high. At the same time, shop owners generally are not getting wealthy. It is very possible that a disproportionate share of the service dollar goes to cover inadequate, faulty, or uneconomical training. If so, a solution to the problem would be reflected in increased profits to service shops, manufacturers, and might even benefit the public in lowered charges. Certainly there are enough dollars being spent in the service field today to pay the costs of such a study and undertaking.

This, then, is the problem of the industry at large, and I believe that the industry will eventually recognize it. Meanwhile, the individual shop has its own job to do. Each shop is an individual enterprise with its own characteristics and no pat formula can be set up to fit them all. There are basic principles, though, that must be recognized as fitting all shops from the largest to the smallest. The first is to realize that training programs are probably here to stay. A shop owner must acknowledge the fact that he must provide some form of training and then try to make it a controlled item. He must study the training tools available in his area, pick out those with the least overlap and the least amount of specialized commercial

(Continued on page 172)

NEW COMMUNICATIONS RECEIVER

HE new National Model NC-88 is a good example of a communicationstype receiver of high performance and rugged dependability. It has been designed to fill the needs of many varied classes, from the amateur and short-wave listener to the many commercial services and civil defense groups. Eight miniature type tubes plus rectifier are utilized in a modern superheterodyne circuit with a continuous frequency coverage of 540 kc. to 40 mc. Both voice and radiotelegraphy reception are provided to permit world-wide coverage over the entire range. The complete frequency coverage of the NC-88 is separated into four bands, with the entire main tuning dial and the 10, 11, 15, 20, 40, and 80 meter amateur bands on the bandspread dial calibrated directly in megacycles. A logging scale on the bandspread dial permits relative calibration of bandspread tuning anywhere within the range of the receiver, while clear markings on both dials, including location of the new civil defense frequencies, contribute to ease of operation.

A phono jack has been installed on



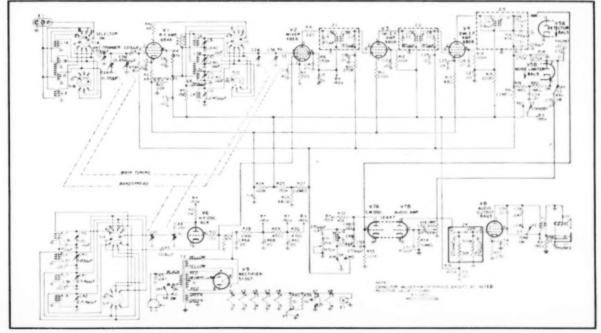
## Details on a receiver of good performance and rugged dependability which covers all bands 540 kc. to 40 mc.

the rear of the chassis to accommodate most types of record players in use today, permitting the receiver to be used for music reproduction. Audio is delivered to the built-in loudspeaker, while a two-position tone switch gives the listener his choice of crisp treble or rich bass response. The delayed automatic gain control circuit compensates for fluctuations in the strength of the received signal due to

atmospheric conditions, etc., while an extremely effective automatic noise limiter circuit provides maximum suppression of most types of objectionable noise.

Audio output is provided by the built-in five-inch permanent magnet loudspeaker or at the headphone jack located on the front panel. The headphone load impedance is not critical, (Continued on page 148)

Schematic diagram of the National Model NC-88 communications receiver for amateur, s.w., commercial, and civil delense use,



# FUNDAMENTALS OF COLOR

#### MILTON S. KIVER

Pres., Television Communications Institute

Part 1. Color fundamentals and their application in

color television for radio and TV service technicians.

OLOR forms one of the most intimale contacts in our everyday life we wear colored clothes, we use colored objects, we live in colored houses, and we eat colored food. Yet, in spite of this close contact with color. most people have only a casual knowledge of the nature of color or of color mixing. To the television technician. color possesses added significance because of its application in color television. Such terms as color primaries, hue, saturation, chromaticity, and luminance will be commonly used in any description of a color television receiver, both from the standpoint of operation and of service. What do these words mean? How do they tie in with color television? These are some of the questions the service technician will be confronted with and now, while the art is still young, is as good a time as any to learn about them

Let us start off with color primaries. Anyone who has ever experimented with projector lamps has discovered that when different colored lights from several projectors are combined, the resultant color seen by an observer will differ from the color of any of the projected beams. Thus, for example, yellow can be formed by combining red and green light; white light can be produced by combining red, green, and blue. The color of the light formed will appear to the eye as a complete color and the eye will be unable to distinguish the various components of the mixture that united to form the new

This method of color formation is illustrated in Fig. 1A. Two circles of colored light are projected onto a screen and positioned so that they overlap to some extent. Within the overlapping region, a new color will be produced by the addition of color "A" and color "B." Where the circles of light do not overlap, each light will retain its original color. If a third circle of light is added, as shown in Fig. 1B, then a maximum of seven colors can be obtained. These would be: color "A," color "B," color "C," color "D" (formed from "A" and "B"), color "E" (formed from "A" and "C,"), color "F" (formed from "B" and "C"), and color "G" (formed from "A." "B." and "C")

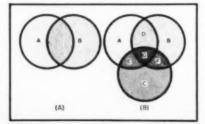
—and each would differ from the other. In the areas where the circles of light overlapped, the eye would not be able to distinguish each of the colors forming the mixture, but instead would see the final color produced. Thus, color "A" and "B" would not appear to the eye as color "A" and color "B," but as some new color which we can call color "D." The same would be true of each of the other combinations.

The number of different colors that can be formed by the use of three colored lights, as shown in Fig. 1B, will depend upon the colors chosen. Experience has indicated that the colors red.

EDITOR'S NOTE: Although color television is a commercial reality, few TV service technicians will have the opportunity to install or work with sets for some time to come. In the meantime, the service technician can ground himself thoroughly on the fundamentals of the subject so as to be prepared when color TV sets become widely available. This article is the first of a series that will attempt to present all the background necessary for the servicing of color TV receivers. Actual schematic diagrams of color TV sets will be analyzed when they become available and once the fundamentals of color TV have been thoroughly convered. Of course, other articles in Radio & Tellevision News will present the ladest advances in color TV as they occur.

blue, and green, when combined with each other in various proportions, will produce a wider range (or gamut) of colors than any other combination of three colors. Note, however, that if we used four different colors in our mixing process, we could produce an even greater number of different colors.

Fig. 1. (A) A new color is formed between color "A" and color "B" as a result of mixing color "A" and color "B". (B) Adding three original colors. "A". "B", and "C", results in four new ones.



With the addition of more and more colors to our mixing scheme, the reproducible range would widen somewhat. Obviously, however, a line must be drawn and the use of three colors has been standardized. The three colors chosen, red, green, and blue, are thus referred to as the "primary" colors although, as we shall see, the use of the word primary has been widely misinterpreted to mean that red, green, and blue will, in various combinations, reproduce all colors. This is only in a special instance.

The reason why three primaries were chosen, in preference to say four, probably stems from the belief that the eve behaves as though it contains three sets of nerves, with each set of nerves responsive to a different portion of the visible spectrum. Thus, one set of nerves has its greatest sensitivity in the blue region: another set is most sensitive in the green region; and the third set is most sensitive to red. Whether or not three sets of nerves actually exist has never been absolutely established. However, since the eve reacts as though such a condition does exist, it is reasonable to work on the assumption that it does.

The theory which serves to explain the ability of the human eye to distinguish various colors can also be employed to explain color blindness. In the eyes of a color-blind person, all of the color sensitive nerves or retinal cones react in the same way to all colors. Hence, when colored light is viewed by these people, all three sets of nerves are similarly stimulated and the same result is obtained as though equal amounts of red, green, and blue light were intermixed. The color seen would be white, or some intermediate shade of grey. These people can distinguish between dark and light, but no more

There are also people whose retinal cones differ sufficiently to see some of the colors, but not all. These people are known as partially color blind. Perhaps the best known instance of this is green and red color blindness. In the eyes of these people green or red appears grey. Fortunately, however, over 90 per-cent of the population have normal vision, which means

# COLOR ANALYSIS

that they are able to distinguish between all of the spectrum colors.

A diagram which is very convenient to use for color mixing is the tongue-shaped (or horseshoe-shaped) curve shown in Fig. 2. (Another name for this curve is

chromaticity diagram.)

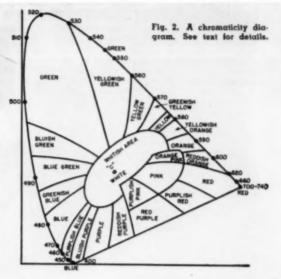
Around the perimeter of this curve are listed numbers that range from 400 at the lower left-hand corner to 740 at the farthest point to the right. These figures represent the wavelength of various spectrum colors in millimicrons. Thus, purple (violet) extends from approximately 400 to 450, blue extends from 450 to 500 millimicrons, green extends from 500 to 570 millimicrons, yellow extends from 570 to 590 millimicrons, orange extends from 590 to 610 millimicrons, and red extends from 610 to 740 millimicrons.

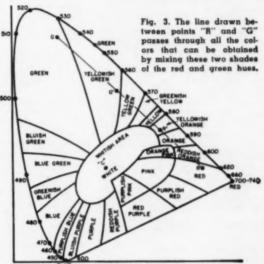
Any point not actually on the solid-line curve but within the diagram represents not a pure spectrum color but some mixture of spectrum colors. Since white is such a mixture, it, too, lies within this diagram; specifically, at point "C." This particular point was chosen at an international convention in England and is generally referred to as "illuminant C." Actually, of course, there is no specific white light, since sunlight, skylight, and daylight are all forms of white light and yet the components of each differ considerably. The color quality of a conventional blackand-white television receiver tube is represented by some point in the central region of the diagram about point "C."

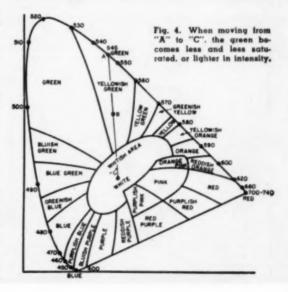
The chromaticity chart lends itself readily to color mixing because a straight line joining any two points on the curve will indicate all the different color variations that can be obtained by combining these two colors additively. Thus, consider a line drawn connecting points "R" and "G" representing certain shades of red and green respectively. See Fig. 3. If there is more red light than green light, the exact point representing the new color will lie on the line, but be closer to "R" than "G." Point "R!" might be such a color. On the other hand, if a greater percentage of green light is employed, the color will still lie on the line connecting "R" and "G," but now, it will be closer to "G" than "R." Point "G!" might be such a color. This same line of reasoning can be carried out for any two colors on the chart.

(On the screen of a three-gun tri-color picture tube we can carry out the same experiment by turning off the blue gun and permitting only the electron beams from the green and red guns to reach the phosphor-dot screen. As one beam, say that from the red gun, is made more intense, the resultant color on the screen shifts closer to red. On the other hand, if the red gun is turned down and the green gun beam is turned up, the resultant color takes on more and more of a greenish cast. When both guns are producing beams of equal intensity, yellow will be seen.)

Point "C," in the central region of this diagram, is taken to represent white or daylight. If we draw a line between point "C" and any point around the curve, we have a mixture of white light and a particular spectrum color. Thus, in Fig. 4, a line connects point "C" and green at 545 millimicrons (point "A"), indicating a mixture of white light and spectrum green. If the amount of white light is zero, then the pure spectrum green will be produced. As white light is added, the hue of the green changes and the point representing this mixture moves along the line toward point "C." We might consider this as diluting the green, causing it to become lighter and lighter.







(In a color tube, we dilute a solid color, say green, by adding more red and blue. The red and blue combines with some of the green to form white, thereby reducing the intensity or depth

of the green.)

It is possible to specify the saturation of a color by its distance from point "C." Thus, consider point "B" in Fig. 4. This is half way between point and point "A" and represents a mixture of green diluted 50 per-cent with white light. The saturation of the green at point "B" is 50 per-cent. Had the distance between point "C" and point "B" been 75 per-cent of the total distance between point "C" and point "A." we would have stated that the saturation of the color at point "B" was 75 per-cent. By moving point "B" closer and closer to the spectrum curve, its purity increases until it becomes 100 per-cent at the curve-point "A." By moving point "B" closer to point "C," its saturation decreases. At point "C," the saturation is said to be zero.

In connection with saturation, the word hue is frequently heard. Hue represents colors such as red, green, orange, etc. It is associated with color wavelength and when we label a certain color as green, or orange, or red, we are specifying its hue. Thus, hue refers to the basic color as it appears to us, while saturation tells us how deep the color is. If the color is highly saturated we say that it is a deep color, such as deep red, or deep green. If it contains a considerable amount of white light, we say it appears faded or pale, as a faded red or a pale green. Hue and saturation are psychological terms representing the observer's impression of a color and hence they cannot be defined as precisely as wavelength

At the bottom end of the chromaticity curve, on the line drawn from deep blue to red, there is a series of colors which are combinations of red and blue in various proportions. These

range from bluish purple to purplish red. It can be seen that this line completes the curve of Fig. 2. However, this line should not be considered in the same sense as the rest of the curve. It does not contain any spectrum colors but only combinations obtained from mixing spectrum colors. Because of this, the region at the back end of this tongue-shaped curve is known as the region of non-spectral colors. The boundaries of this region are obtained by drawing dotted lines from point "C" to red at 700 millimicrons and from point "C" to blue at 450 millimicrons. The remainder of the diagram above these dotted lines is known as the region of spectral colors. The entire diagram is known as the domain of real colors.

One further term used in connection with this diagram is complementary color. Any two colors which can by themselves form white are known as complementary colors. Thus, in Fig. 5, the line connecting point "F" with point "G" passes through point "C" and hence, the colors at "F" and "G" are said to be complementary to each other

We have previously seen that a line drawn between two points representing two different colors contains all of the combinations that can be derived using those two colors. If, now, we wish to determine what range or gamut of colors can be obtained from any three given colors (say "R," "G," and "B<sub>1</sub>"), we would draw connecting lines to each of the colors. See Fig. 6. The result is a triangle. We can produce any color within this triangle by various combinations of the three colors, "R," "G,," and "B,."

The wavelengths of "R," "G," and "B<sub>1</sub>" chosen for television fall near 610 millimicrons for the red, near 540 millimicrons for the green, and near 470 millimicrons for the blue. These are actually the values used for the triangle drawn in Fig. 6 and by studying this diagram you can see the extent of the color range obtainable on a color television receiver. Note that colors not included within the triangle will not be reproduced by any combination of the three primary colors chosen.

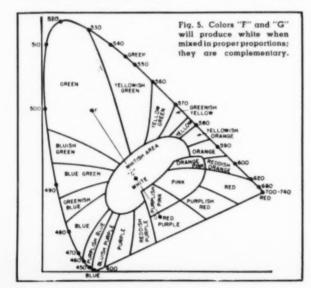
This, of course, brings us back again to the statement made previously, that three primary colors cannot reproduce all colors simply by adding the three primary colors together. In color television, of course, only those colors which can be produced by adding the primaries together can be considered. this being the only practical approach

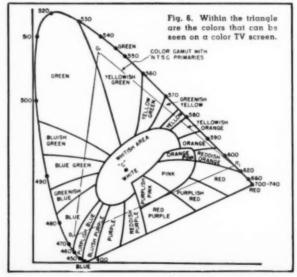
The choice of suitable primary colors for television depends principally upon what type of color phosphors can be obtained for the receiver picture tube. Originally it was felt that the color picture would be traced out on a blackand-white screen and then the light passed through a color filter to present the observer with the "color" image. This was the method employed in the CBS system and in the early forms of the RCA system. However, with the development of a color tube, phosphors are employed which emit colored light directly, leading to a less cumbersome system physically and a more efficient system optically.

A considerable amount of research work is being done on evolving phosphors which will provide as wide a gamut of colors as possible. In recent tubes, a willemite phosphor (Zn: SiO: Mn) was used for the green, a sulphide phosphor (ZnS:Ag:MgO) for the blue, and a third phosphor, Zn, (PO<sub>4</sub>)<sub>2</sub>: Mn for the red. These primaries provide a fairly wide range of colors, as seen in Fig. 6. By comparison, the area covered by printing inks is much smaller. It may be that as the art advances, the color range of the phosphors will be extended, although the colors now obtainable are wholly satisfactory.

When the NTSC system of color television was under development, a considerable amount of research was

(Continued on page 157)





## BUILDING A MULTIMETER

By ROBERT HILLIARD Robert Hilliard Company

Build this compact, versatile test instrument. A 0-1 ma. meter, with its scale redrawn, is used for this unit.

ONSTRUCTION articles describing various sorts of multimeters have been more plentiful than unique. Generally these units consist of a lowrange milliammeter with a switching system and multipliers which permit a number of different functions to be read on a single indicator.

The circuit of the multitester to be described is novel in several respects. Among the unique features is resistor  $R_1$  in Fig. 1A. Its function will be discussed in some detail later in the article. The a.c.-d.c. switching system is rather unorthodox in that the input of the bridge system is floating across the meter in the d.c. position. Although this does offer a shunt of several thousand ohms across a 100-ohm meter circuit, its effect is negligible and the savings offered by the resulting simplified switching arrangement are worth-

The balance of the circuit consists of a current-type ohmmeter in the  $R \times 100$ position and a voltage divider system in the  $R \times 1$  position. Two current scales are provided, one covering the 0-10 ma. range and the other the 0-100 ma. range. These two scales are sufficient for most multimeter applications.

The four voltage ranges are provided by series multipliers in the positive meter leg. All functions are selected by a two-deck, non-shorting type, 11position wafer switch and the d.p.d.t. a.c.-d.c. switch. The output is read directly across a 500-ohm line through the 0 to 10 volt a.c. position and the db scale. An external .25 µfd. condenser is used if a d.c. component is present.

The components used in this circuit were chosen for their ready availability at most radio wholesale houses. Stock values are used throughout and most junk boxes will yield the bulk of the items needed. Naturally the builder may have to series or parallel a resistor or two to obtain exact values but this is common practice and is entirely acceptable in this construction.

The first step in assembling the multimeter is to prepare the front panel as shown in the photograph since all parts are attached to it. The holes are drilled for the components and the template supplied with the 0-1 ma. meter used to locate the meter cut-out. If you already have the meter or have obtained a surplus unit you will have





Two views of the meter panel on which all component parts are mounted.

to make a template for your meter out of paper.

When the holes are drilled and all burrs removed, a coat of primer is applied followed by a coat or two of enamel. Auto body gunmetal grey was used in the author's model. When completely dry, the surface was satin finished by rubbing it lightly with fine steel wool. Rub in one direction only for professional-looking results. The switch plate decal was then positioned over the holes provided in the panel.

Next, the meter was disassembled and the new scale (Fig. 2) was cemented in place on the reverse side of the dial plate. This was done to preserve the original scale for future reconversion should the need arise. The location of this scale is very important and this operation must be performed carefully.

When the face is mounted the meter is re-assembled and installed in the panel. The rest of the components are now installed on the panel as indicated in the left-hand photograph. The selector switch is placed in the center hole in such a way that its two stack screws rur laterally and the pole connectors are on the right, as viewed from the back. The a.c.-d.c. switch is in the right-hand upper hole and the rheostat is placed in the left-hand upper hole. The jacks are located in the two 5/16" holes at the bottom.

After the parts have been mounted, you are now ready to begin wiring. Care should be taken to provide good solder joints and to keep the leads short and dressed. If a 5000-volt range is employed, be sure to take the necessary precautions regarding high-voltage insulation.

The battery leads consist of two four-inch lengths of wire. One lead is connected to the center post of the (Continued on page 174)

Fig. 1. (A) Complete circuit diagram of the multimeter. (B) Circuit for checking the exact resistance of meter if data is lacking.

R<sub>1</sub>—Sec text R<sub>2</sub>—10,000 ohm, 1/2 w. res.

ohm, 1 w. res. ±1% (shunt for 100 ma

30 ohm, 1/2 w. res. ±1%

D.p.d.t. toggle switch D.p. 11-pos. switch (Mallory 1321-L or

3 volt battery (two 11/2 volt flashlight cells

-0.1 d.c. milliampere meter (either 3" or 412" meter can be used) SR, SR, SR, SR, Full wave meter rectifier, div

0 (4) 200 TO IM



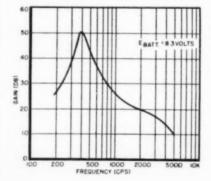
#### This small transistor receiver for model control features negligible battery drain and is fairly easy to construct.

OTHING in recent years has captured the interest of the electronics fraternity quite like the introduction of the transistor. Although first announced in 1948, it was not until very recently that reliable units in large quantities were brought within the reach of all of us. Today there are perhaps 20 or 30 firms manufacturing both point contact and junction types and their products are available at almost any large radio supply store. Surely this field of development is still in its infancy and we can be certain that the future will bring many new types of transistors with characteristics to meet the requirements of practically any application.

The recent issues of this and other technical magazines have pretty well covered the principles of operation of the point contact type and the junction type transistors. However, most of us feel that the best way to become familiar with a new device is to incorporate it in something we build ourselves, measure its characteristics, and observe its performance. This article will describe an interesting. practical application of both types of presently-available transistors.

My hobby, for a number of years, has been building and flying radiocontrolled model airplanes. Many different types of radio receivers have been used during this period. Each has its good points and its bad features. The requirements for this kind of service are much the same as for any really portable equipment. Light weight, of course, is of prime importance, not only in the receiver itself but particularly of the batteries required for operation. This is the same as saying the current consumption must be held to an absolute minimum if reasonable life is to be obtained with lightweight batteries. The sensitivity must be as good as possible because usually an inefficient receiving antenna must be used. The receiver must be able to absorb a lot of mechanical punishment. You can imagine the shock to which this equipment is subjected when a model plane dives into the ground from several hundred feet altitude under full throttle. Still, a well constructed receiver in a properly designed mounting will survive this sort of treatment. These requirements point very strongly toward

Fig. 2. Response of audio amplifier stages.



TRANSISTOR RECEIVER

> JOSEPH M. HUGHES WYVHJ

what is perhaps the simplest type of receiver, the superregenerative.

One of the most foolproof versions of a superregenerative receiver for model airplanes was described by Howard McEntee in the September 1951 issue of RADIO & TELEVISION News. It consists of a superregenerative detector, a stage of audio amplification, and a biased detector operating a relay. Three subminiature tubes are used. The characteristic rushing noise output of the detector in the absence of an incoming signal is amplified and by grid rectification is used to bias the final tube to cut-off. When a signal (unmodulated carrier) is received, the rushing noise from the superregenerative stage disappears. The bias is removed from the last stage and the plate current increases. This operates a sensitive relay in the plate circuit and its contacts are used to energize the control mechanism.

An application such as this looks like a "natural" for transistors. They are light in weight, consume no heater power which means a great saving in battery weight, and have a much longer expected life than any vacuum tube. This is some compensation for their greater initial cost. They too are practically free from microphonic noise which can become a problem when the equipment is subjected to severe vibration as it is in model airplane use. Even the shock from a crash landing should mean nothing to a transistor

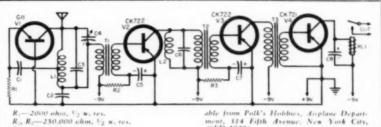
The picture, however, is not quite as rosy as it seems. Most radio control operation is done either on the 50-54 mc. amateur band, the Citizens Band at 460-470 mc., or the new "license free" spot frequency at 27.255 mc. At this time there are no transistors generally available which will operate at any of these frequencies although several manufacturers have models under development which are capable of oscillating at frequencies higher than 100 mc. There are several point contact transistors presently on the market which will operate satisfactorily up to 3 or 4 mc. The equipment to be described operates on the

160-meter amateur band. Currently available junction transistors are primarily suited for audio frequency use because of very limited high frequency response.

another consideration which must not be overlooked. Transistors are inherently much noisier than vacuum tubes. For example, most point contact transistors have a noise figure around 50 db, while the figure for junction transistors is around 20 db. The noise figure for a good vacuum tube is on the order of 4 to 6 db. Without going into detail we can see that any transistor amplifier we build will be inherently much noisier than a vacuum-tube amplifier with the same amount of gain. This, then, will be one of the factors which determine the minimum signal level our receiver will be able to distinguish from the noise created within the receiver itself. It should be remembered that noise power is a function of bandwidth, so by reducing the bandwidth of our system this difficulty may be somewhat minimized.

When transistor amplifier stages are cascaded we must also remember that they are essentially power amplifiers. The low-impedance input circuit actually absorbs power from the driving source so some form of matching device, usually a transformer, must be used to efficiently couple the highimpedance output circuit of one stage to the low-impedance input of the next stage. This is quite different from the conventional class A vacuum-tube stage where the input circuit approaches infinite impedance at audio frequencies. Typical power gain for a junction transistor stage is 30-40 db while a single tube stage may have a theoretical power gain of infinity but will easily realize 70-80 db gain in practice. Remember we are speaking of power gain. Obviously a highgain amplifier will need more stages if transistors are used than it would if tubes were used.

Fig. 1 is a photograph and Fig. 3 is the schematic diagram of the receiver.  $V_1$  is a point-contact transistor with a usable current gain up to about 3 mc. The superregenerative stage is essentially a Hartley oscillator. However, the transistor in a grounded-base circuit such as this does not produce a phase reversal between input and output voltages as a tube would do. This is the reason the tap on the tank circuit coil is coupled to the input circuit, rather than the bottom of the coil as is done in vacuum-tube Hartley oscillator circuits. The stage operates as a self-quenched superregenerative detector with the values of  $R_1$ ,  $C_1$ ,  $C_2$ , and the resistance of the primary winding of T, determining the quench frequen-Although this frequency is not critical it must be somewhat greater than the highest modulation frequency the receiver will be expected to handle. On the other hand the quench frequency must not be so high that the superregenerative stage can not operate with discrete bursts of oscilla-



-,002 µfd., 150 v. cond

.0047 µfd., 150 v. cond.

4-30 μμfd, ceramic trimmer cond. C., C.—4 μfd., 60 v. tantalum elec. cond. (Fansteel Corp., 2200 Sheridan Rd., North Chicago, III.)

C .- . 2 ufd., 150 v. cond. (two .1 ufd. in parallel !

-Miniature plate-to-line trans, (LTC SO-1) -Subminiature plate-to-line trans. (UTC.

RL -- 4000 ohm polarized sensitive relay (Avail-

= ED-4000

L.—32 t. #32 Formex wire, c.t., wound or Superex (formerly Grayburne) "Vari-Loopstick"

form (old winding removed)

—800 mby, toroidal inductance (Available from Communication Accessories Co., Box 7, Hickman Mills, Mo., Type 206)

Point-contact transistor (General Electric

V - "p-n-p" junction transistor (Raytheon Type CK722)

"p-n p" junction transistor (Raytheon Type CK721)

Fig. 3. Schematic of superregenerative transistor receiver for model airplane control.

tion. The presence of an incoming signal increases the quench frequency in this type of operation. This brings about a condition of "coherence" which shows up as multiple resonance peaks in the selectivity curve when the incoming signal is extremely strong and the quench frequency is too high.

V- is a conventional grounded-emitter stage of audio-frequency amplification with about 30 db maximum gain. The base current is approximately 50 µa. and the collector current .3 ma. L2-C6 is a parallel-resonant circuit tuned to 400 cps bridged across the primary of the output transformer.  $L_2$  is an 800 mhy, toroidal inductance which has a "Q" of about 15 at this frequency. This resonant circuit across Tr results in maximum gain at 400 cps and yet gives appreciable discrimination against the noise inherent to  $V_1$ (random in frequency) and to the quench frequency which in this case is around 10 kc. V1 is a conventional amplifier stage. The over-all gain as a function of frequency of these two stages is shown in Fig. 2. If this re-

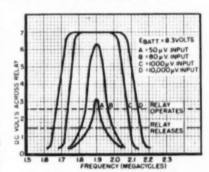


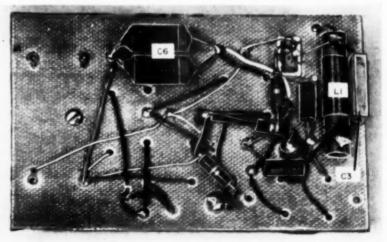
Fig. 4. Selectivity curves for the superregenerative receiver for various inputs.

ceiver were to be used for voice-modulated signals the resonant circuit would be eliminated at some sacrifice in signal-to-noise ratio.

V<sub>1</sub> operates essentially as a class B amplifier or a "plate" detector. When there is no input signal the collector current is very low, only a few microamperes. The negative half cycles of

(Continued on page 91)

Fig. 5. Underchassis view of transistor receiver showing simplicity of the wiring.





# SERVICING

TAPE





By WILLIAM ROCKWELL
Authorized Factory Service Company, Inc.





Whether you are interested in servicing tape recorders as a business, or in repairing your own machine, this article will give you some valuable tips you can use.

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IN THE past few years the hometype tape recorder has gained tremendous popularity and, as a result, there have been at least thirty-five different machines manufactured to date, with the list still growing. What does this mean to the radio and television technician? He can continue his present line of servicing and forget that tape recorders exist; or he can familiarize himself with the different types of machines on the market, and in so doing, he can add tape recorders to his list of services and add new avenues of profit to his business.

To date there have been few, if any, articles written on home tape-recorder service and, as a result, the service technician has been stymied because of the lack of information. That is the purpose of this article—to acquaint the service technician with some of the troubles he can expect to encounter when servicing these machines.

A tape recorder consists of three basic sections:

1. The recording amplifier

The playback amplifier
 The tape transport mechanism

In the home-type tape recorder, the recording and playback amplifier are one, with the different functions selected by a "record-listen" switch. This switch, when in the "record" position. connects the record and playback coil in the head assembly (one coil performs both functions) to the output of the amplifier which supplies the audio voltage to be recorded. In this position, the switch also converts the output stage to an oscillator, usually 30 to 50 kc., to provide bias for the recording head and also erase current for the erase coil in the head. (On some machines a separate bias and erase oscillater is used.) Equalization is also inserted in the amplifier to compensate for frequency response characteristics of the head and tape speed. This

equalization is in the form of highfrequency boost. This increases the signal-to-noise ratio of the recording during playback.

In the "playback" position, the recording coil in the head assembly is connected to the input of the amplifier. The bias oscillator is converted back into an output stage, and the high-frequency boost is removed. The equalization in the "playback" position is different than in the "record" position. The high-frequency response is attenuated to retain the balance of the original program material, and the low-frequency response is boosted. The low-frequency equalization is accomplished during playback rather than during recording to prevent the low-frequency components from saturating the tape.

Now we come to the mechanical side of the subject which, in most cases, will be the main source of repairs. This is because the tape recorder is subject to all the woes of any mechanical device. These are: 1. dirt, 2. wear, and 3. lubrication.

A tape transport mechanism must meet certain requirements and perform certain functions in order to qualify for the exacting job it has to perform:

1. Its speed must be constant (wow and flutter held to a low value)

2. It must be quiet in operation

3. It must be able to stand a fair

amount of abuse

All this must be accomplished and still keep the machine at a price the public can afford. At the present state of the art, it is simple to produce an amplifier whose response is flat to 8000 cps which, in most cases, is the upper limit at a tape speed of 7½" per second. It is not quite so simple, however, to produce a good mechanism that meets the aforementioned requirements.

A tape transport mechanism consists of the following basic sections:

1. A capstan and flywheel assembly which pulls the tape past the recordand erase-head assembly at a constant rate of speed, usually 3\(^3\) or 7\(^1\)2" per second. This capstan and flywheel assembly is driven by a fairly heavy motor through a rubber idler wheel. The tape is held against the capstan by a spring-loaded rubber pressure roller, and against the heads by a pressure-pad assembly. See Fig. 1.

2. A take-up spindle assembly. This take-up spindle is usually driven by the motor that drives the flywheel through some form of clutch. See Fig. 2. This clutch is needed because the diameter of the take-up reel is constantly changing as it takes up tape, causing it to pull more tape with each revolution, but, the capstan will only feed the tape at a constant rate, so the clutch supplies the necessary slippage.

3. A rewind spindle assembly. This can be driven from the flywheel by a belt or from the motor shaft by a rubber idler wheel. See Fig. 3.

## Mechanical Servicing

As stated previously, most of the troubles encountered will be in the tape transport mechanism. The most common offenders will be the rubber wheels used to drive the different moving parts. These wheels will become glazed and start slipping or they will wear and get lumpy, causing wow and flutter. The rubber pressure roller will become foul with oxide from the tape and start to slip. If any oil gets on any of the rubber wheels, they will be ruined.

Wheels that have become glazed after considerable use can be restored by cleaning with alcohol or by holding a piece of fine sandpaper on the wheel while it is running. Be careful not to remove too much rubber if sandpaper is used. Wheels that have had oil on them must be replaced. Cleaning will not help, since oil gets into the pores of the rubber and will seep out.

Motors should be lubricated with one or two drops of No. 10 motor oil. Be sure that no oil gets on any of the driving surfaces. Cams and levers should be lubricated with a small amount of light grease on the bearing surfaces only. If possible, refer to the manufacturer's lubrication instructions.

The pole pieces in the recording head or heads are also subject to considerable wear. The tape used for magnetic recording is coated with a metal oxide which acts as a fine abrasive, something like crocus cloth. When the pole pieces wear down, the machine will not record and erase properly because the gap dimensions change, causing low volume, poor high-frequency response, and incomplete erase.

Examine the pole pieces with a jeweler's loupe or magnifying glass and notice if the gap is worn or uneven. The "record" gap should be a very fine line, and the spacing along the full length of the gap should be even. The "erase" pole piece has a gap about four or five times the size of the "record" gap, and this also should be even along the full length of the gap. A sure check would be to compare an old head with a new one.

Improper recording and erasing can also be caused by a dirty head. Be sure the head is free from all oxide that may come off the tape. When replacing heads or pole pieces, they must be peaked for maximum high-frequency response. This is done by running a test tape with 7500 cps recorded on it, made on a machine known to be good, and slowly rocking the head back and forth until maximum response is obtained. Then lock the head in position.

Wow and flutter can be traced by listening to its rate, and watching for drive wheels or pulleys that turn at the same rate. For example, a fast flutter would not be caused by a pressure roller that turns at a slower speed than the rate of flutter. Speed should be checked by making a recording of music with piano or wind instruments and listening for wow and flutter. There are instruments made for the measurement of wow and flutter, but these instruments are priced at approximately \$500 and therefore, are out of the reach of the average service technician. A 1000-cycle note can also be used for these checks, and after listening to this note on a number of machines the service technician will be able to determine whether the machine is operating properly.

Some precautions to observe when servicing are the following:

Don't over-lubricate.

Don't use carbon tetrachloride to clean rubber wheels as this will ruin them. Use alcohol.

Don't wash oilite bearings in any type of solvent. If you do, you will remove all oil from the pores of the bearing.

Don't use magnetized tools near the recording heads. Be careful not to scratch or mar the pole pieces.

Don't check heads with an ohmmeter unless absolutely necessary, or the heads will become heavily magnetized and cause a high hiss in the background of the recording. If the head does become magnetized, use a head demagnetizer, which should be available from any large supply house that sells recording equipment. If one is not available, place the head near a strong 60-cycle a.c. field, and slowly reduce the field to zero. Do this a number of times.

Make sure the tape being used on the recorder has the correct wind. Tape comes in two winds; "A" wind, which has the oxide wound facing the hub of the reel, and "B" wind, which has the oxide wound facing away from the hub. After threading the tape through the machine, the oxide or dull side of the tape should be against the heads.

Electrical Servicing

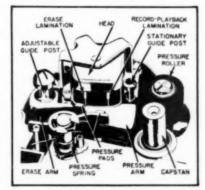
All of the troubles encountered in the amplifier of a tape recorder will respond to conventional servicing techniques. One of the common sources of trouble is the bias-erase oscillator. When this does not function, the machine will not erase and the recordings will be low in volume and very distorted. A quick check can be made by placing a neon bulb on the plate of the oscillator and also on the leads going to the head. If the bulb glows, you can be reasonably sure the oscillator is working. Also, check for worn or dirty pole pieces as they will give the same type of symptoms.

For exact voltage and resistance values, refer to the manufacturer's service manual. When replacing noisy resistors, especially in the low-level stages, be sure to shunt the heat of the soldering iron away from the new resistors, otherwise the new resistors will be as noisy as the old ones. To shunt the soldering iron heat away from the resistor either use a pair of long-nose pliers from the resistor lead to the chassis, or an alligator clip to the chassis.

Following is a list of a few of the tools and lubricants which will be needed in addition to the tools found in the average service shop:

A complete set of Allen and Bristol wrenches.

Fig. 1. The head assembly and capstan of a typical tape recorder. Note that the head assembly includes the record-playback and erase heads in one unit.



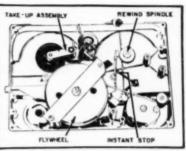


Fig. 2. Shown here is a typical method of using a flywheel for driving the takeup reel of a tape recorder. The flywheel is coupled to the motor via an idler.

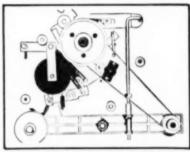


Fig. 3. The rewind spindle in the lower right is driven by means of a chain belt from the motor in the system shown here.

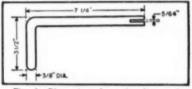


Fig. 4. Dimensions for a bending tool useful for entering inaccessible places in the tape recorder for slight adjustments.

- A set of small sized open-end wrenches.
- A bending tool (see Fig. 4) for getting into otherwise inaccessible places in the tape recorder works, for slight bending when necessary.
- A good test tape containing a 7500 cps note for head alignment.
  - 5. A head demagnetizer.
- A light grade of grease or lubricant.
  - 7. No. 10 motor oil.
- 8. Penetrating oil for freeing frozen bearings.
- Alcohol for cleaning rubber drive wheels and belts.
- Carbon tetrachloride for cleaning metal parts.
- 11. A complete set of tape recorder service manuals available either from the manufacturers directly, or from some of the various radio and television service manual and book publishers.

The service technician interested in the theory of magnetic tape recording should read some of the excellent books on this subject appearing in recent years, as well as magazine articles which will keep him up to date.



#### By BERT WHYTE

HE term "Certified" in the title of this column may puzzle some readers who missed the first review when it was introduced last year. For the benefit of these readers and as a restatement of our basic policy, we hasten to explain. As you know, we name the equipment used in reviewing the recordings each month. The naming of this equipment does not necessarily constitute an endorsement of this particular equipment. If we seem to use one certain brand of equipment more consistently than any other, it is primarily for reasons of convenience. In other words, the material is at hand and is familiar enough to quickly and thoroughly test. That is what "Certified" means. Each link in the chain of reproduction, from pickup to speaker is checked and rechecked to make absolutely certain that everything is in perfect operating condition. It is only fair to evaluate a recording when this situation exists. It is not right to impose the possibility of defective equipment when reviewing records. Listening to phonograph records is a subjective thing at best; to accuse a record of being inherently distorted, when the distortion actually stems from poor equipment, is to do the manufacturer of the recording and the public a great disservice. Still another factor is important in reviewing records and that is the acoustical environment

It is said most people listen to records under "living room" conditions. This is a somewhat misleading term, since the size, shape, reflection, and absorption characteristics of walls and floors and the type of furnishing are all variables, and what is true in 10,000 rooms isn't necessarily true in 10,000 other rooms. The brightness of a recording can be changed by such a simple thing as whether the drapes in a room are open or closed! It is because of this that we published a listing of the acoustic conditions under which recordings were reviewed.

I have moved since the first appearance of this column and will list herein my present acoustical conditions: room 26 x 15 ft., 20 ft. of drapes along one wall which may be left at full 20 ft. or reduced to 6 ft. A hard reflective wall with a speaker in each corner, a hard wall opposite speaker wall, extra large (16') sectional sofa, several other up-

holstered chairs, wall-to-wall carpeting, conventional plaster ceiling. This is a considerably better room for listening than my previous one. Just "live" enough with barely 2-3 seconds reverberation time. Some people I know like a little longer reverb period. That's because they haven't lived with binaural! Believe me, binaural sound in a room with a reverb period over 3 seconds can drive you goofy!

In playing monaural material, disc and tape, I use both speakers phased properly to give me a diffuse sound source. Well, that's my new set-up. If you have a comparable room and equipment of equal quality and your hearing is "normal," you should get just about the same results as I do. However, I must stress again the great number of variables and the subjectivity of listening to music. What is golden to my ear may be garbage to yours and vice versa. All I, or any other critic, can do is to call your attention to what is an apparent fault or virtue in a given recording. That a critic should make his analysis under as carefully controlled conditions as possible, goes without saying. It's a pity so few adhere to this line of reasoning:

Equipment used this month: Weathers pickup and arm, Rek-O-Kut T12H turntable, Fisher Master Audio Control, two 30-watt McIntosh amplifiers, two Jensen G-610 Triaxial speakers in a Read "Fold-a-flex" enclosure.

RAVEL

CONCERTO IN D MAJOR FOR THE LEFT HAND FOR PIANO AND ORCHESTRA CONCERTO IN G MAJOR FOR PI-ANO AND ORCHESTRA

Jacqueline Blancard, pianist, with L'Orchestre de la Suisse Romande conducted by Ernest Ansermet. London 11.797, ffre curve. Price \$5.95.

This recording may come as quite a surprise to a great many people since London has already issued an LP with the identical repertoire. Of course the other LP was issued in the very early days of London's entry into the long-play field and it left something to be desired in the way of sound quality. London is to be commended once again for "upgrading" an existing part of its

The opinions expressed in this column are those of the periewer and do not necessarily reflect the views or opinions of the editors or the publisher of this magazine.

catalogue with this new recording. Those of you who feel a little "put-out" with this state of affairs since you already own the older version, should really take heart that a magnificent new recording of these Ravel works is available. If you liked the music enough to buy the older job, then you'll really go for the new one. It's a far better effort than the previous disc. Soundwise it's one of the best piano recordings on LP. There was no flutter in piano tone that I could detect and what tone! Here is truly exciting piano. Properly percussive in a score that calls for prodigious percussiveness and yet a piano that can sing as well. The orchestral accompaniment is something wonderful to hear with splehdid, solid bass and sharp biting brass. The opening woodwinds in the "Left Hand" are a marvel of sonority. The jazzy, percussive figurings of the "G Major" are crisp and clean with plenty of punch. Both concerti are played with verve and spirit by Mme. Blancard. On the older disc Mme. Blancard shared honors with another fine pianist Nicole Henriot.

This new recording arrived just about the time I was able to hear Mme. Henriot play the "G Major" with Mitropoulos and the N. Y. Philharmonic in concert. Strangely, there was little to choose between Mme. Henriot's interpretation and that of Blancard, Blancard's was perhaps more academic, more linear than the volatile reading of Henriot. Other than that, both pianists displayed brilliant technique coupled with solid musicianship. (A note in passing but it always seems to me that the Ravel piano concerti are apparently the exclusive province of women pianists. I cannot recall a male interpretation of these works for a long, long time.)

Mr. Ansermet is a particularly astute gentleman when it comes to conducting Ravel. His readings are always masterful and most obviously a labor of love. In these recordings he chose just the right tempi and was able to keep his orchestra well in hand. The ffrr curve reproduced well with no cut or boost necessary in treble or bass. Surfaces in my copy were quiet. In every respect a superior recording.

MOZART SYMPHONY #38 IN D SYMPHONY #34 IN C

Chicago Symphony Orchestra conducted by Rafael Kubelik. Mercury "Olympian" MG50015, AES curve. Price 85.95.

As noted last month this is Rafael Kubelik's swan song with Mercury and the Chicago Symphony. It is rather fitting that he leaves us with this splendid reading of "The Prague," a score always dear to the heart of a son of Bohemia. That Mr. Kubelik has made his mark in phonographic history is not surprising. His previous efforts for Mercury in a very catholic repertoire have been outstanding. I was sorry to hear of Mr. Kubelik's col-

RADIO & TELEVISION NEWS

# 1954 TV RECEIVER SPECIFICATIONS

The electrical and mechanical specifications listed below are of direct aid to service technicians. This list will be continued in forthcoming issues to include all major manufacturers.

MFR.	CHASSIS	TUNER	LF.	VIDEO	AUDIO	ES SWEEP	P.S.	CRT	VIDEO I.F. FREQ. (MC.)	H.V.4 (KV.)	U.H.F. PRO- VISION	POWER	SPECIA FEA- TURES
	19B1	6BZ7	6CB6	6ALS	6AU6	12AU7, 6S4	5U4G	17'	25.75	15	Stripe	185	
	19F1	or	6CB6	6CB6	6ALS	68N7GT, 6BQ6GT	1B3GT	21.	28.75	15	Strips	185	
	19F2Z	6BCS	en8*	1	6AV6	6AX4GT, 6U8*		21'	25.75	15	Strips	185	8, 9
	19A2	636			6AS5			21"	25.75	15	Strips	185	
	19D2		1	1	or			21'	25.75	15	Strips	185	9
	19G2				6Y6G			24"	25.75	18	Strips	185	
	1981							17"	25.75	15	11	195	
	19J1							21"	25.75	15	11	195	
	19B2							21"	25.75	15	11	195	
	19E2							21	25.75	15	11	195	9
	19K2Z							21	25.75	15	11	195	8, 9
	19H2			1				24"	25.75	18	11	195	
	19 <b>T</b> 1							17	45.75	15	11	195	
	19L2							21-	45.75	15	11	195	
	19L2Z			1				21	45.75	15	11	195	8
7	19 <b>M</b> 2							21.	45.75	15	11	195	9
ADMIRAL	19N2Z							21-	45.75	15	11	195	8, 9
M	19W1							21"	45.75	15	11	195	
\$	19R2							24	45.75	18	11	195	
	22Г2	6BZ7	6CB6	12AT7*	12AT7*	68N7GT, 12AU7	1B3GT	21'	25.75	17.5	Strips	200	
	22F2Z	6J6 6CB6		6CL6	6AU6	684, 6ALS	5U4G	21*	25.75	17.5	Strips	200	8
	22A3Z		6AG5	6AU6	6ALS 6AV6	68N7GT, 6BQ6GT 6AX4GT		21.	25.75	17.5	Strips	200	8
	22D3Z		92	1			1	21.	25.75	17.5	Strips	200	8, 9
	22G2		6AU6		6V6GT			21.	25.75	17.5	11	235	
	22G2Z							21'	25.75	17.5	11	235	8
	22B3Z							21'	25.75	17.5	11	235	8
	22J2Z							21	45.75	17.5	11	235	8
	22H3Z							21"	45.75	17.5	11	235	8
	23E1Z	6BZ7	6CB6	12AT7*	12AT7*	6SN7GT, 6AV5GT	1B3GT	24"	25.75	19	Strips	235	8
	23B1Z	6J6	6CB6	6AU6	6AU6	12AU7, 6AL5	SU4G	27"	25.75	19	Strips	235	8
	23F1Z		6AGS	ecl6	6ALS	6SN7GT, 6CD6G	5U4G	24"	25.75	19	11	235	8
	23C1Z				6AV6	6 <b>V</b> 3		27"	25.75	19	11	235	8
	23H1Z			1	6V6GT			24"	45.75	19	11	235	8
	23J1Z							27"	45.75	19	11	235	8
-	VN-21	6BK7	6CB6	1N105	6AU6	12AX7, 12AU7	SU4	21ZP4A	45.75	15	Strips.		
ANDREA		6J6	6CB6	6AH6 6AU6	6ALS 6AV6	684, 12AU7 6BQ6, 6AX4	5U4 1B3				or 11	190	10
CAPEHART	CX-37	6BQ7 6J6	6CB6 6CB6 6CB6	1N64 6X8 6AQ5	6K6 6X8° 6BN6 6BK5	6BE6, 12AU7 12AU7, 6BF6 6V6GT, 6BQ6GT	5U4G 1B3GT	17LP4 21EP4A 21EP4B		14	Strips	210	5, 10
CAPI			6CB6	6AU6		6W4GT	1	21ZP4B 21ZP4A					

Video i.f. tubes only. 2. Includes detector and a.g.c. 3. Includes sync section and a.f.c. 4. CRT 2nd anode voltage, 5. Removable safety glass. 6. Local-fringe a.g.c. adjustment. 7. High-fidelity sound. 8. Aluminised picture tube. 9. TV-radio-phono combination. 10. Built-in antenna, 11. 82-channel tuner. 12. Adjustable dial light. \*Part of tube is used in another section.

(Continued next month.)

HOW'S YOUR

RUMBLE?

Ву

JAMES A. MITCHELL

HIGH-FIDELITY fan was describing his new speaker system, "It sounds terrific! The highs are there. The bass is solid. But when we come to a quiet part in the music there is some infernal background noise like someone upstairs moving furniture. It seems that I have acquired a rumble problem." This experience is becoming a common one as speakers with improved bass response come into general use. Unless we learn to select and adjust audio equipment for low noise and rumble, good audio reproduction will not be enjoyed.

The main source of rumble is the mechanical movement of the turntable. However, each part of the audio system (Fig. 4) can greatly influence the amount and kind of low-frequency noise actually heard. For example, speaker baffles such as open back phonographs which do not produce much response below 75 cps seldom produce rumble. The new corner horns and other improved baffles extend bass response as far as 30 cps. Whether rumble will be objectionable with these speakers depends on the quality and condition of the rest of the equipment, the room acoustics, and the listening habits of the user. With these conditions constant, the lower the response of the speaker system the more rumble will be heard.

From point of view of rumble many amplifiers have too good a low frequency response. I have seen amplifiers which will drive a speaker cone back and forth in rhythm with each turn of an eccentric 78 rpm record. Such amplifiers make tremendous demands on turntables and records. Do not assume that because rumble cannot be heard that it cannot affect your sound. The speaker movements due to rumble can be below the response of the baffle so are not heard, yet they can drive the voice coil into the nonlinear extremes of motion and produce intermodulation distortion. Sometimes the reduction in distortion with elimination of the rumble is noticeable.

The preamplifier used has a great



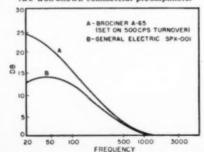
Fig. 1. Measuring the rhythm of turntable rumble to locate source.

# How to establish the causes of low-frequency noise in wide range record playing systems and corrective steps to apply.

effect on rumble because it is the bass boost in the record equalization circuit of the preamp which amplifies the low frequency noise so much. To provide the correct compensation for records with a 500 cps turnover recording curve the preamp must boost 50 cps 20 db more than 1000 cps and 25 cps 26 db more than 1000 cps. Fig. 2 shows the equalization curves of two preamplifiers. Curve B is the G-E SPX-001, a moderately priced unit for home use. Curve A is the Brociner A-65 set on the 500 cps turnover position. This is a precision unit for use with wide range equipment. Note the large difference in bass amplification, over 12 decibels below 40 cps. Each of these units has an optimum use, but on wide-range equipment the amount of rumble heard will be very different.

Preamplifiers are often the source of some low-frequency noise themselves. Hum is a common problem. Tube noise can cause trouble because of the high amplification of the low frequencies.

Fig. 2. Low-frequency equalization for two well-known commercial preamplifiers.



Nearly all modern pickup cartridges have excellent bass response. major cause of emphasized rumble is the tendency of some cartridge arm combinations to have a resonant peak in the low frequencies. This often happens with the short, light arms which are common on record changers. One good way to test for arm resonance is to measure the output of the amplifier while playing a test record with a good low-frequency sweep. The Cook Series 10 has such a band extending down to 35 cps. Playing it at 33 rpm allows you to test down to 15 cps. With a G-E cartridge in one record changer arm a peak of about 5 decibels was found at 26 cps. While this is of no consequence in a limited-range system it can greatly increase the rumble in a wide range system. The same G-E cartridge in a long professional arm showed no such resonance.

When we consider the demands we have made on the turntables with our modern recording systems it is not surprising that we hear rumble. The microgroove record has about 260 lines-per-inch and a maximum groove "wiggle" of about 3 thousandths of an inch. Now since bass frequencies are recorded at constant amplitude, a vibration of 3 thousandths of an inch at any bass frequency will be a rumble as loud as the maximum recording level. If the vibration in the turntable is 3 ten-thousandths of an inch the rumble will be 20 db below the maximum recording level or about the average loudness of the music. This is plenty objectionable. If you want the rumble to be 30 db below the average recording level, and this is just acceptable for wide range systems, the vibration is limited to one hundredthousandth of an inch! Vibration in the turntable can originate in the motor, the drive wheels and bearings, the rubber drive idler, and the turntable rim and bearings. In order for the vibration to be heard it must be transmitted to the record surface and must be in a direction that produces response in the pickup. Sometimes changing the position of an arm relative to the turntable can lower rumble

#### Rumble Measurements

In analyzing a rumble problem in a hi-fi installation it is worthwhile to make certain measurements of the low-frequency noise level as this can help to locate the sources of the trouble and indicate the type of correction needed. The equipment required is simple. An audio test record such as the Cook Series 10 or the Dubbings phonograph test record can provide the recorded source of tones. An audio oscillator can also be useful. The preferred meter is an a. c. vacuum-tube voltmeter such as the Heathkit AV-2. An a. c. multimeter can be used if measurements are made on the 500 ohm output of the amplifier. The meter must be capable of measuring flat to 20 cps. The set-up is shown in Fig. 1.

First, it is good practice to determine the actual low-frequency response of the preamplifier and amplifier using the oscillator. This will tell if the preamp has proper, insufficient, or excessive equalization. It should be noted that rumble measurements can only be compared from one audio system to another when exactly the same response and equalization are obtained.

Now to measure the various sources of low-frequency noise connect the proper size resistor in place of the speaker and connect the a. c. voltmeter across the resistor. See Fig. 3. Put the test record on and track the 1000-cycle tone as a reference. Adjust the volume level so that a meter reading is obtained within the power limits of the amplifier and preferably 50 db above the lowest meter reading that can be made. Set this reference level without the interference of rumble. If your tone control does not affect the 1000-cycle tones turn the bass down when adjusting the level. Record the reference level in decibels and return the bass control to normal for the rest of the measurements. Now without change in gain place the stylus in an unrecorded groove. The Dubbings record has a specific band for this. Record the level in decibels and report the total noise and rumble as decibels below the reference level.

To determine the amount of noise contributed by the various parts of the equipment make the following tests, without change in the volume control.

Amplifier Noise: Disconnect the preamp from the amplifier being careful to leave no ungrounded leads to the input. Record the noise level in deci-



Table 1. Noise and rumble for turntables or changers for various listening conditions.

bels. Normally this should be 60 decibels or more below the reference. Higher readings are indicative of faulty tubes or improper design.

Preamplifier Noise: Reconnect the preamplifier but disconnect the lead from the pickup. Set the equalization to 500 cps turnover if it is adjustable. Record the meter reading as db below the reference. The reading should be between -35 db for home type equipment to -60 db for the best professional types.

Induced Hum in the Pickup: Plug in the pickup. Turn on the turntable and hold the pickup directly over but not touching the record. The increase in noise over the previous reading is due to hum induced in the pickup. Check the shielding on the pickup lead. Also make sure that the turntable and arm are well grounded and that the unit is not close to unshielded transformers.

External Vibration: Place the pickup in a record groove with the turntable turned off. Any increase in noise when the pickup is placed in the groove, compared to being held just above it, indicates external vibration. Better spring mounting of the turntable can help reduce this rumble.

Turntable Motor Vibration: Remove the idler drive wheel from the record changer or turntable so that the phono motor can be turned on without the turntable rotating. Place the stylus in a record groove and turn the motor on. The increase in noise over the previous two readings is a measure of motor quality and condition. One way to tell if the motor bearings are worn is to make this same reading with a new unit of the same type substituted.

Turntable Rotation Vibration: Replace the idler drive wheel and with the turntable going place the stylus in the unrecorded groove of the test record. Record the total noise and rumble. The increase in noise level over the previous reading is the noise and rumble due to the rotation of the

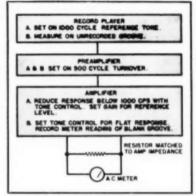


Fig. 3. Block diagram of the low frequency noise and rumble test set-up. See text.

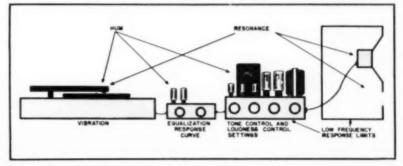
Accumulated	High	Fidelit	y Syst	ema'
Sources of Noise	A	B	C	10
Main Amplifier	-60	60	72	91
	-38	-38	-21	-44
Induced Hum in the				
Pickup	33	-36	18	-31
External Vibration	-32	-36	10	-39
Turntable Motor Vi-				
bration	-18	-31	-12	- 29
Turntable Rotation Vi-				-
bration (Total Noise				
and Rumble)	-14	- 29		-26
* See text for descripti				2.0
Db below standard re				tone

Table 2. Noise and rumble measurements

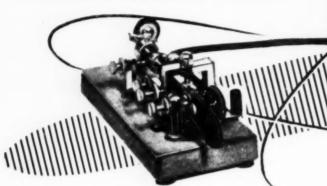
turntable and the idler drive. This is usually the largest source of rumble after the motor and is an indication of the condition and quality of the bearings, drive surfaces, and roundness of the idler. It is common experience to have the meter show considerable variation during this reading. This is due to uneven roughness of the drive wheels and turntable rim. It is often possible to detect the location of rough spots on the rim by watching the rhythm of the meter movement and the turntable revolutions.

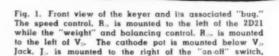
Table 2 lists a series of rumble and noise measurements for typical equip-(Continued on page 168)

Fig. 4. Factors affecting low-frequency noise and rumble in record playing systems.



# "SELF-COMPLETING" ELECTRONIC KEY





# By JACK D. GALLAGHER, WSHZB

Construction details on an economical keyer which requires no elaborate mechanical changes in the "bug" used with it.

URING the past few years numerous electronic keys have been described which were designed to reduce strain on the operator and to improve the character of the transmitted signal. The operation of the earlier models was based on the action of a multivibrator, electronically connected to a keyer tube, or connected through a d.c. amplifier to a keyer tube. The plate circuit of the keyer tube was connected to a relay, which keyed the transmitter. The dot-to-dash ratio was governed by the difference in condenser capacities, which was controlled by a contact on the switching mechanism. Unless the operator used exact timing, clipping of signals resulted.

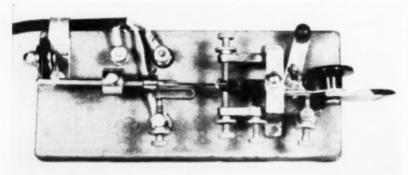
Later models of electronic keys eliminated the multivibrator circuit in favor of a circuit consisting of two relays interconnected between vacuum tubes which caused the keying relay to operate in a more precise manner. The dot-to-dash ratios were improved and the feature of self-completing dots and dashes aided the operator tremendously. It was now impossible to cut dots and dashes short by improper timing, since the circuit was designed to complete one operation before another could be started. Of course, the main disadvantage with this circuit was the two relays that had to be adjusted. Other disadvantages were the number of parts, the number of tubes used, and the power supply requirements

In order to provide a simpler, more economical keyer, the author described a circuit in the January, 1953 issue of RADIO & TELEVISION NEWS which used only one relay and provided the self-completing action through the use of a small thyratron. However, in order to use the "bug," a few mechanical changes were necessary. Providing extra contacts, insulating contact screws, and other modifications destroyed the future usefulness of the "bug" as a semi-automatic key.

The "bug" modification for the keyer described in this article does not destroy its usefulness as a semi-automatic key, nor are there any complicated mechanical changes to be made. No additional contacts are necessary, and there are no insulating problems.

A brief description of the circuit and the photographs will make clear its simplicity and ease of construction. The pulse circuit consists of a 2D21 thyratron gas tube, V1, connected to the timing circuit and the grid of a cathode coupler. The 8.2 megohm resistor connected to the grid of V, is returned to the cathode. This resistor causes a small negative "contact" potential when the circuit is completed by closing the key. In order to make the "bug" operate without contact additions, the electrical connection is removed between the dot and dash contact posts. The dot contact post is connected to the grid of V:s, and the dash contact post is connected to the ungrounded terminal of C. The frame of the "bug" is connected to the plate of the 2D21. When the key is in the neutral position, the voltage builds up on the timing circuit, consisting of  $C_{ij}$  $R_0$ , and  $R_0$ . The condenser,  $C_0$ , becomes charged since this section of  $V_0$  has zero grid bias. The cathode of  $V_{24}$  is connected to the grid of  $V_{zB}$  through 27,000 ohms. The voltage drop through this resistor causes approximately three volts positive bias on V:n, which results in a heavier plate current flow in this section of the tube. The keying re-

Fig. 2. Close-up view of the "bug" showing the three-conductor cable fastened to the spring arm stop with a cable clamp. See text for details on key modifications.



lay is connected from the plate of  $V_{zz}$  to the arm of a "balancing" potentiometer,  $R_{zz}$ . In the idle condition, the balancing potentiometer is adjusted for zero voltage across the relay winding.

Operating the "bug" lever to the dash position causes the following action:

1. The timing condenser is grounded through  $V_{\cdot}$ .

2. Since the voltage is above the firing point, the tube fires and immediately discharges the timing condenser and grounds the grid of  $V_{zz}$ .

3. As the timing condenser is discharged, the voltage across  $V_i$  reaches the extinguishing point and will not fire again until the voltage has risen to the firing point. (This action of the thyratron provides the self-completing action in this circuit.)

4. As the grid of  $V_{ix}$  is momentarily grounded through  $V_{ix}$  the plate current of  $V_{ix}$  is cut off. This causes the voltage across the cathode load resistor and the timing circuit to decrease.

5. Since this timing circuit is connected to the grid of the second section of  $V_{2i}$ , the decrease in voltage will cause the grid of  $V_{2i}$  to become negative with respect to its cathode.  $V_{1i}$  is momentarily cut off.

6. The relay is in one arm of a Wheatstone bridge circuit, and in the idle condition the voltage across the relay winding is adjusted to zero. When dashes are being made, the bridge is unbalanced, and the voltage at the plate of  $V_{zn}$  rises. This change in voltage causes the relay to operate.

As soon as the voltage across  $V_1$  reaches the extinguishing point, the circuit tends to resume its idle circuit condition. The grid-to-cathode voltage of  $V_{14}$  drops toward zero causing the plate current to flow through the tube which recharges the timing circuit. As long as the dash contacts are closed, the thyratron will reach the firing point and repeat the operation.

When dots are made, the following action takes place:

1. The operation of the "bug" to the dot position places  $R_z$  in series with the plate of the pulse tube,  $V_{t_0}$  and the timing condenser,  $C_{t_0}$ . The operation of the thyratron is not affected since it will fire and extinguish as the voltage between its plate and cathode rises and falls.

2. The voltage discharged from the timing condenser is a different value because of the voltage drop across  $R_2$ . The grid of  $V_{14}$  is grounded through  $V_4$ .

3. Since the timing condenser is not discharged as completely as it was in the case when producing dashes, the condenser recharges in a shorter interval of time. Holding the dot contact closed results in the same action as that described for producing dashes, except that the circuit now produces shorter relay contact closures, or dots.

Within certain limits, the adjustment of  $R_z$  to values other than 33,000 ohms will result in different dash-to-dot ratios. Higher values of plate voltage than that shown in the diagram may (Continued on page 146)

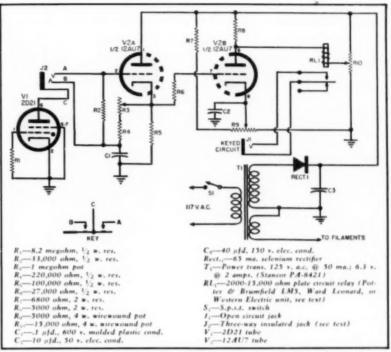
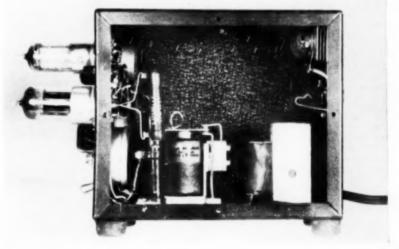


Fig. 3. Complete schematic of keyer. A 2D21 thyratron was selected for its small size.

RELAY TYPES	CONDITION		V			Vzn					
(See Text)	CONDITION	1	2	3	6	7	8				
Ward Leonard	Key Up	138	65	96	78	46	43				
adjustable	Dots	142	23	30	96	30	30				
2000 ohm coil	Dashes	142	16	24	105	23	28				
Western Electric	Key Up	138	66	97	82	47	44				
non-adjustable	Dots	142	23	30	105	30	31				
4000 ohm coil	Dashes	144	16	24	112	23	28				
Surplus "BK-35"	Key Up	138	65	96	78	46	43				
adjustable	Dots	142	23	30	109	30	31				
13,000 ohm coil	Dashes	142	16	24	114	23	28				
Potter & Brumfield	Key Up	138	64	97	78	46	43				
adjustable	Dots	142	23	30	103	30	31				
10,000 ohm coil	Dashes	142	16	24	112	23	28				

Table 1. Voltage readings for the four different types of relays tried by the author.

Fig. 4. Side view of keyer. Contact spacing adjustment on relay is indicated here.



# A TRANSISTORIZED APPLAUSE METER



Build this compact unit for rental or "loan." It can be used as an output meter or for sound-survey work.

WITH the increasing general interest in square-dance competitions, amateur shows, and similar contests, the radio-TV service shop is frequently in a position to pick up extra money or to obtain good publicity by renting or lending and installing p.a. systems, record players, and juke boxes. General practice is to rent the systems or equipment to clubs and money-raising groups, and to "lend" the systems to churches and similar charitable organizations.

At such contests, prizes are often awarded on the basis of "audience reaction." The only fair way to determine audience reaction to a particular act is by means of the impartial judgment of an electronic applause meter. In this way, there is no possibility of favoritism on the part of the emcee, nor any question as to the fairness of decisions

Since the radio-TV service shop may be called on to furnish or operate the p.a. system, it is only natural that it also be requested to supply or obtain an applause meter or similar de-Commercial applause meters may not only be difficult to obtain locally but quite expensive, so the service organization handling such work may find it worthwhile to consider building its own instrument.

In choosing the design for such an instrument, several features are desirable. The applause meter should be self-contained, compact, light weight, sensitive, easy to use, and, preferably, independent of both the power line

and the p.a. system. These last two features are important because the instrument may sometimes be used outdoors where power is not available or in small groups where a p.a. system is not needed.

The instrument shown in Fig. 1 comes close to meeting all of these requirements. It is completely self-contained. No extra "mike" or other pickup is required. It is compact as the over-all dimensions are only 4"x6"x 414". It is quite sensitive, yet easy to operate and use—only three simple controls are provided. It is battery operated and no power line connections are necessary!

These features have been made possible by utilizing p-n-p junction transistors in the design of the instrument.

#### Circuit Description

The complete schematic diagram for the transistorized applause meter is given in Fig. 2. The basic circuit consists of a two-stage transformercoupled transistor amplifier followed by a single stage combination amplifier-detector. A built-in crystal microphone cartridge (Mic.) serves as the

In operation, audio signals picked up by the microphone are applied to the primary of transformer  $T_0$ , a stepdown unit used to match the high impedance of the crystal microphone to the low input impedance of the first transistor amplifier stage.

In order to adjust the gain of the

By LOUIS E. GARNER, JR.

instrument for different sized audiences, a simple step-type attenuator, consisting of rotary switch S, and resistors  $R_1$ ,  $R_2$ ,  $R_3$ ,  $R_4$ , and  $R_5$ , is provided between the secondary winding of T, and the input to the CK721 amplifier stage.

The audio signal obtained from the "arm" of S, is applied through coupling condenser  $C_1$  to the base of the transistor, connected as a conventional 'grounded-emitter" amplifier. basic circuit has been used throughout the instrument as it provides good gain and permits a single battery power source to be employed.

Resistor R4 serves as the "base return" resistor. Connected to the negative terminal of the power supply, it establishes the base current "bias" for the first stage.

Transformer  $T_i$  is used to match the high output impedance of the first stage to the low input impedance of the second stage, a CK722 "groundedemitter" amplifier. The primary winding of this transformer serves as the collector load for the CK721 stage.

Coupling condenser C1 offers a low impedance path for the audio signal to the base of the CK722 amplifier. yet prevents the secondary winding of T: from acting as a d.c. short from base to ground.  $R_1$  is the base return resistor for the second stage; again, the value of this resistor determines the base "bias" current.

Condenser C<sub>3</sub> serves to bypass the

higher frequency components of the audio signal and thus to reduce the effects of high-pitched whistles on the final meter reading. This condenser also reduces, to some extent, the amplitude of the noise "hiss" generated by transistor amplifier stages.

If desired, crystal headphones may be inserted in the monitor jack,  $J_{ij}$ coupled to the second amplifier stage through condenser C. This provision permits the operator to hear the signal as picked up by the applause

Transformer T serves to perform a function similar to that of  $T_i$ , that is, its primary winding serves as the collector "load" for the second amplifier stage, and it is used to match the high output impedance of one stage to the low input impedance of the next.

C. serves as the coupling condenser to the last stage, a CK722 transistor operated without base "bias" current. Note that base resistor R, is returned directly to ground rather than to

When a transistor amplifier is op-

erated without base "bias" current, it acts to rectify as well as to amplify the applied signal. Thus, collector current depends directly on the amplitude of the applied audio signal and this current is indicated on the microammeter,  $M_{\rm b}$ .

Provision is made for "smoothing out" the peaks of audio signals by means of a large capacity bypass condenser,  $C_4$ , across the meter. The use of this filter is optional with the operator, since it may be thrown out of the circuit by means of switch  $S_3$ .

Power for the entire instrument is obtained from a single 6 volt battery,  $B_{11}$ , controlled by a s. p. s. t. power switch,  $S_{22}$ 

#### Construction Hints

The assembly and wiring of the instrument are straightforward and should present no problem to the skilled technician. The placement of major parts is apparent from the interior view of the instrument given in Fig. 3. The microphone cartridge and the input transformer  $(T_i)$  are mounted on the back panel.

A small chassis is used for the transistor circuits. An under chassis view is not shown because the final wiring, with the author's layout, must be done with the chassis in place.

The subminiature transformers are held in place by small "Z" brackets.

Wiring and layout are not especially critical, and the builder may modify the layout shown or choose a new one to suit his own requirements. Care should be taken to follow good audio practice, that is, leads should be kept reasonably short and the "input" and "output" portions of the instrument should be kept well separated.

Although the author's model has been assembled in a standard sloping panel utility box, another type cabinet may be preferred by the builder. Almost any small metal box will serve well in this capacity; a *Bud* "Minibox" is a good choice.

The transformer leads are identified by color-coded wires—the proper connections are shown in Fig. 2 for the transformers specified in the parts list.

In rare instances it may be found necessary to readjust the values of the "base return" resistors  $R_{\rm e}$  and  $R_{\rm f}$  for optimum results with a particular transistor. To do this experimentally, connect an audio sine-wave generator to the input and an oscilloscope to the output of the stage to be checked. Adjust the value of the resistor for best gain with minimum distortion, but in no case choose a value which permits the collector current to rise above 5 ma.

The builder can use one of two methods when installing the transistors. He may either use sockets or wire the transistors directly into the circuit. Should sockets be preferred, standard 5-pin subminiature tube sockets are suitable.

If the transistors are to be soldered in position, however, special care

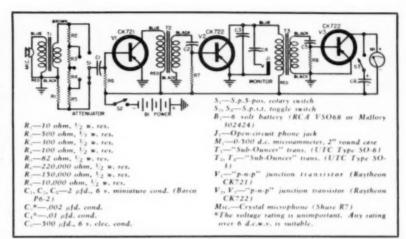


Fig. 2. Complete schematic of the transistorized applause meter. The "p.n.p" type junction transistor has been used in this construction. Three are required.

should be exercised to complete the soldering as quickly as possible to avoid possible damage by overheating these expensive components.

#### Circuit Modifications

A considerable number of modifications in the basic applause meter circuit are possible to meet the special needs of the individual builder. However, because the number of possibilities is so large, only a few suggestions are outlined here.

First, the monitor circuit may be eliminated entirely if desired. Simply remove  $C_1$  and  $J_2$ . No other circuit changes are necessary.

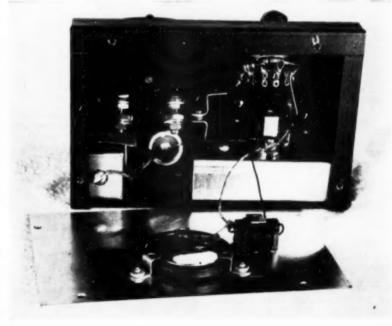
Another meter may be substituted for the 0-500 microampere unit specified in the parts list without making any other circuit changes. An 0-100

microammeter will provide increased sensitivity, while less sensitivity will be obtained with a 0-1 ma. unit. Irrespective of the meter chosen, however, care must be taken to set the attenuator so that serious overload will not occur. The exact setting will vary with different sized audiences.

In the author's model, the resistors in the attenuation network  $(R_1, R_2, R_3, R_4, R_5)$  were chosen arbitrarily and no attempt was made to provide a precise degree of attenuation at each switch position. This method was employed since the instrument is used only to indicate relative peaks and exact meter readings are unimportant.

Some builders might prefer that the attenuator switch provide precise steps of attenuation, either in terms (Continued on page 120)

Fig. 3. Rear view of instrument. Microphone and transformer are mounted on the panel.



# International SHORT-WAVE

## Compiled by KENNETH R. BOORD

THIS month's ISW Department finds a heavy file of reports from listeners all over the world who obviously have had good luck with their DXing.

Albania—Radio Tirana, 7.850A, noted opening English session 1400. (Pearce, England)

Andorra—Radio Andorra, 5.990, noted 1730 with recordings. (Saremba, Va.)

Anglo-Egyptian Sudan Radio Omdurman, 7,093A, noted with news 1115 on Sun., Wed. (Pearce, England) Heard on 6,593A at 2315-2345, all-Arabic; best after 2330. (Stark, Texas)

Angola—Luanda, 11.862, varies its announcements; at times still says "Radio Clube de Angola," at others "Radio Angola," and sometimes "Radio Angola, Emissor Nacional." Noted around 1500-1530 and later. (Pearce, England)

Argentina LRS, 9.316, Radio Splendid, noted 2115 with piano selections. (Tandrow, Calif.) News noted 1800A over LRA, 15.345. (Smits, Minn.) Heard on this outlet 1800-2000 to North America. (Vokral, N. Y.) Radio El Mundo, LRX, 9.660, 7.5 kw., LRX1, 6.120, 10 kw., is scheduled 0530-2235. (Kahan, Calif.) LRY, 9.76, heard 2215 at excellent level. (del Rosario, Hawaii)

Australia – VLA15, 15.200, noted 2200 at excellent strength in Hawaii. (del Rosario) VLC9, 9.615, noted at strong level 0700-0845. (McGrath, Iowa) VLM4, 4.917, Brisbane, heard 0410-0450 at good level in Home Service. (Morris, Pa.)

Austria—Radio Wien, 9.664, Vienna, noted 0330 with light musicals. Appears now to identify as "Radio Osterreich." Blue Danube Network, 9.617, Salzburg, noted with program preview 1025. (Pearce, England) This one is heard at fair level as late as 1100-1200. (Siggs, Sweden)

Azores — Ponta Delgada, 4.865, noted to 1900 closedown. (ISWL, England) CSA92, 11.090, heard with music 1530-1538. (Morris, Pa.)

Bechuanaland ZNB, 8.230, Mafeking, is heard in Sweden 1200-1300. (Radio Sweden)

Belgium ORU, 9.745, Brussels, noted with recordings, announcements in Portuguese at 1618. Heard on 6.000 at 1700 with Spanish for Latin America. (Pearce, England) Heard closing 0805 on 11.805, fair level; noted on 21.510 with fair signal 0700 when reception improves (may change beam then),

(Gillett, Australia) Heard on 9.767A with interval 1300, French language. (Smits, Minn.) Noted on 15.335 at 1200 in German. (Saremba, Va.)

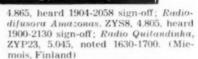
Belgian Congo—Radio Congo Belge, Leopoldville, lists OTM1, 6.295, 0000-0130, 0515-0730, 1130-1600; OTM2, 9.380, 0500-0150—1130-1600; OTM4, 11.720, 0515-0730, OTH, 9.210, 0530-0700, 1130-1330; OTH, 11.670, Sun. only 0500-0700, (Cody, Ireland, others) The 9.380 outlet is good level to 1600 closedown in French, but does have occasional CWQRM. (Jannis, S. C.) Good level when checked 0040. (Barnard, Calif.)

Brazil—ZYK3, 9.565, Radio Jornal do Commercio, Recife, Pernambuco, is good level in the United Kingdom when presents "Brazil Calling" (English) weekdays 2005-2030 (Sun. 1630); ZYK2, 6.085, ZYK32, 11.825, and ZYK33, 15.145, are also used. Radio Cultura du Sao Paulo, 6.165A, is being heard well in Canada around 2330 when announces in English and asks for reception reports, says will send a "novelty" reply from Radio Cultura, Avenida Sao Goao 1285, Sao Paulo, Brazil; no longer uses 9.745. Radio Bandeirante, ZRY77, 6.185, and ZRY78, 11.925, is scheduled now 0400-1100, 1600-0030. (ISWC, London, others)

Radio Record, 9.505, Sao Paulo, heard 1700 with news in Portuguese, (Mesquita e Sousa, Portugal) Radio Tamandare, ZYK21, 3.265, heard 1905-1930; Radio Clube de Para, PRC5,

This young SWL who became a ham is Edward R. Buchholz, W9VBZ of Milwaukee, Wis. Shown are Ed's NC-125 receiver: his transmitter—a Johnson Viking: a Johnson v.l.o.; and the Milwaukee Radio Amateur's Club "Novice Trophy" presented to Ed for the year 1952. His transmitter usually runs 100 watts on the 20- and 75-meter bands. His antenna is a 125-foot center-fed, halfwave, running E.W. about 50 feet in air.





British Guiana—ZFY, 3.220A, Georgetown, Radio Demarara, noted 1845-1915. (Hill. Mass.)

British Honduras — Radio Belize, 3.300, noted 1925-2000 with English, then Spanish news, weather report, and talk in English; heavy CWQRM.

(Morris, Pa.; Kirby, Mo.) Bulgaria—Radio Softa, 9.700, heard well with news 1745. (Roemer, Ky.; Smits, Minn., others) Noted on 7.671A in English 1625-1640 through CWQRM. (Morris, Pa.; Keith, N. Y.)

Burma—Radio Rangoon, 4.774, noted with English 0915-1015. (Miemois, Finland)

Canada—CJCX, 6.010, Sydney, Nova Scotia, has increased power from 1 to 5 kw. (WRH) Heard with news, weather report 0705-0715, then music. (Greco, N. J.) BED, 7.320, Edmonton, Alta., noted 1430, bad QRM, QSB. (Bellington, N. Y.)

Cape Verde Islands—CR4AA, near 7.398, Praia, noted signing on in Portuguese 1500. (Pearce, England) Has news in Portuguese 1545, 1630. (Mesquita e Sousa, Portugal)

Ceylon—VOA relay, 9.57, noted opening 0830 with "Star-Spangled Banner." (Bellington, N. Y.) Radio Ceylon, 11.975, heard 0930-1030 and later at good level. (Jones, N. C., others) Strong at 1100 (Lund, Iowa) Heard on 15.120 in English 2030-2330, announces 7.190 in parallel. (Crowell, Pa.)

China—Radio Peking, measured 15.058, noted with Chinese at dictation speed 2050; at 2100 had time pips, fair level. (Ferguson, N. C.) Heard on 10.210AV with setting-up exercises 1820, parallel 9.060A. (Niblack, Ind.) Heard on 7.450A in native 1820-1915, good level at times; CWQRM. (Morris, Pa.) Peking is being heard on 6.105, 6.200, 9.010A, and 10.200 to sign-off 1334A; on 11.96 at 2200 in English with 15.06 announced as in parallel. (Morgan, Calif.)

(Continued on page 126)

(Note: Unless otherwise indicated, all time is expressed in American EST, add 5 hours for GCT. "News refers to newscasts in the English language. In order to avoid continuous the 24 of ternodeasts. The hours from midnight unit noon are shown as 9000 to 1200 while from 1 pm. to midnight are shown as 1300 to 2400 i. The symbol "V" following a listed frequency indicates "varying." The station may operate either above or below the frequency given. "A" means frequency is approximate.

# TV-RADIO SERVICE TECHNICIAN ASSOCIATIONS

Listed below, by state, are the various TV-radio technician associations in the United States and Canada. Service technicians wishing to obtain more information about their local associations should write direct to one of the officers listed.

#### CALIFORNIA

Long Beach Radio Technicians, Inc., P.O. Box 4085, Long Beach 4—Joseph Martin, Pres.: Merlyn Cochems, Sec'y.

Bureau of Home Appliances of San Diego County. Electric Bidg., San Diego 1— Robert D. Halvorson, Pres.; J. Clark Chamberlain. Sec'y-Mgr.; J. Holloway, Chm. Electronics Div.

San Diego County Electronic Ass'n. Inc., P.O. Box B. Old San Diego Station, San Diego 10—Frederick Palmer, Pres.

Society of Radio & Television Technicians. Inc., P.O. Box 126, Van Nuys— Jimmie Scarsborough, Pres.; Morris Blumbaum, Sec'y.

#### COLORADO

Rocky Mountain Radio-Television Guild. Inc., 8201 West Grandview, Arvada—Milo G. Scram, Pres.: Tom Sampson, Sec'y-Treas.

#### FLORIDA

Radio & Television Technicians Guild of Florida, Inc., 8909 N.W. 22nd Ave., Miami —Shan Desjardins, Pres.: Clarence C. Gunn, Sec'y.

#### ILLINOIS

Greater Chicago Television Service Industry, 135 S. LaSalle St., Chicago 11—Charles Custer, Pres.; M. G. Mackay.

National Alliance of Television & Electronic Service Ass'ns. 5908 S. Troy St., Chicago 29—Frank J. Moch. Pres.: Jack Mc-Dowell, Sec'y-Gen.

National Appliance & Radio-TV Dealers' Assn., 1141 Merchandise Mart, Chicago 54 —Wallace Johnston, Pres.; Victor P. Joerndt. Sec'v.

Television Installation Service Ass'n. of Illinois, 5908 S. Troy St., Chicago 29—Frank J. Moch. Pres.: Rubin Saxner, Sec'y.

#### INDIANA

Radio & Television Service Engineers Ass'n., Inc., 1624 W. 9th St., Anderson— Joe Groves, Pres.; E. J. Deilks, Sec'y,

Radio-TV Service Dealer Ass'n... % Snyder Radio Service. 728 11th St., Columbus— Ralph R. Dwenger, Chm.: J. E. Snyder, Sec'y-Treas.

Radio Servicemen's Ass'n., 701 Hess Ave., Evansville-Wayne Stephan, Pres.; Albert J. Bosler, Sec'y-Treas.

Fort Wayne TV-Radio Appliance Ass'n... 112 East Washington. Fort Wayne 2—Ray Adams. Pres.; Edward H. Sharkey, Sec'y.

Radio Technicians Ass'n., 515 Church St., Ottumwa—Jerry Brown, Sec'y.

#### MARYLAND

Certified Television & Electronics Ass'n. of Maryland, 2861-3 W. Franklin St., Baltimore 23—Harry O. Johnson. Pres.: Jerry Jacobson. Sec'y.

### MASSACHUSETTS

Radio Television Technicians Guild of New England, 212 Massachusetts Ave., Arlington 78—Ben Sims, Pres.; James Stine,

Association of Television Service Engineers, 18 Jackson St., Cambridge—I. Werlin. Pres.; Russell J. Cummings, Sec'y.

Radio Television Technician's Guild of New England, Inc., P.O. Box 1307, Fall River—Jim Shipley, Pres.; Alfred A. Feisal. Sec'y.

#### MICHIGAN

Television Service Ass'n. of Michigan, 16311 Grand River, Detroit 27—Harold Chase, Pres.; M. Wright, Sec'y.

Radio Technicians Ass'n., P.O. Box 773. Kalamazoo Paul M. Goecke, Pres.; James Thayer, Sec'y.

Thayer, Sec'y,
Oakland County Electronic Ass'n.. 286
State St., Pontiac—John Stefanski, Pres.:
James H. Hampton, Sec'y.

#### MINNESOTA

Radio Servicemen of America, 1010 Second Ave., S., Minneapolis—A. R. Trovall.
Rochester Radio & Television Servicemen's Ass'n., 505 11th St., N.W., Rochester
—George McKinzie, Pres.: V. Norman, Sec'y.

#### MISSOURI

Television Service Engineers, Inc., 307 Shukert Bldg., 1115 Grand, Kansas City— Albert A. Richards, Pres.; Ray Crawford, Sec'v.

As'n. of Television Service Companies of Greater St. Louis, Inc., 1724 S. 39th St., St. Louis 10—Vincent J. Lutz, Pres.; Morton Singer, Sec'y.

## NEBRASKA

Nebraska Electronic Service Ass'n., 1617 S. 17th St., Lincoln 2—H. M., Tanquary, Pres.: T. M., Duffield, Sec'y.

#### NEW JERSEY

Radio Servicemen's Ass'n., Inc., 72 S. Olden Ave., Trenton 9—George Owens. Pres.; Louis E. Peoples, Sec'y.

#### NEW YORK

Buffalo Radio Institute Alumni. 45 W. Mohawk St.. Buffalo — Albert Licata. Pres.; Philip Oehler, Sec'y. Radio Technicians Ass'n.. Inc., 657 Broad-

Radio Technicians Ass'n., Inc., 657 Broadway, Buffalo 12—Ted J. Telaak, Pres.; Clarence Jax, Sec'y.

Radio Television Service Ass'n, of Western N. Y., Station E., Box 78, Buffalo-Ferdinand J. Lynn, Pres.: John G. Wick, Sec'y.

Long Island Electronic Technicians Ass'n.. 88 4th St. Oceanside. L.I.—William Carey. Pres.: H. F. MacFarland. Exec. Sec'y. Long Island Television & Radio Techni-

Long Island Television & Radio Technicians Guild, 23 Broadway, Hicksville, L. I., —John A. Wheaton, Pres.: Henry Wawryck, Sec'y.

Editor's Nate: Although every attempt has been made to make this list as complete as possible, some groups may have been omitted. If the afficers of any such group will send in the exact name, address, and list of officers, we will be kappy to include this information in one of our future issues.

Radio Technicians Guild of Rochester. N. Y., Inc., 703 Temple Bidg., Rochester 4— Alfred L. Best, Pres.; Francis G. Stoffel, Sec'v.

Associated Radio-Television Servicemen of N. Y., Inc., 855 Midland Ave., Yonkers— Max Leibowitz, Pres.; Arthur Rhine, Exec, Sec'v.

#### OHIO

Associated Radio & Television Service Dealers, 2552 N. High St., Columbus—Sam Oppenheimer, Pres.; Robert Tyo, Sec'y,

Electronic Technicians Ass'n. of Toledo, 626 Pleasant Place, Toledo 9—Vern B. LaPlante, Chm.: Orville G. Shanteau, Sec'y.

#### OKLAHOMA

Oklahoma City Television & Radio Service Ass'n.. 2909 N.W. 23rd St.. Oklahoma City—H. O. Eales. Pres.: Harry E. Dent. Sec'y-Treas.

#### PENNSYLVANIA

Lehigh Valley Radio Servicemen's Asa'n.. Radio Station WSAN. 39 N. 10th St., Allentown—Claude Kramer. Pres.: Ed Ehritz.

Federation of Radio Servicemen's Ass'ns. of Pa., Carbondale—Milan J. Krupa, Chm.; Leon J. Helk, Sec'y.

Alle-Kiski Chapter of the National Appliance & Radio-TV Dealers Ass'n.. P.O. Box 283, Brackenridge—Penny Martin, NARDA

Conestoga Television Ass'n., 915 New Holland Ave., Lancaster—Lewis I. Mengle, Pres.: Robert G. Wiegand, Sec'y.

Joint Electronics & Radio Committee on Service, Lewis Tower Bldg., Philadelphia— Paul V. Forte, Exec. Sec'y.

Philadelphia Radio Service Men's Ass'n., Inc., 1307 W. Rockland St., Philadelphia 40 —Samuel Brenner, Pres.; Fred Cohen.

Television Contractors Ass'n., Lewis Tower Bldg., 15th & Locust Sts., Philadelphia 2.—Albert M. Haas, Pres.: Martin Weinberg, Sec'y.

Television Servicing Dealers Ass'n.. 6021 Ogontz Ave., Philadelphia—Louis J. Smith. Pres.: Martin Benoff. Sec'y.

Radio Servicemen's Ass'n. of Luzerne County. P.O. Box 309, Wilkes-Barre—William Morgan, Jr., Pres.: Milan J. Krupa, Sec'y.

#### RHODE ISLAND

R. I. Radiomen's Business Ass'n., P.O. Box 800, Providence 1—Hugo Olobri, Pres.; Edward Oliver, Sec'y.

#### TEXAS

Fort Worth Radio & Television Ass'n., Inc., 1610 Eighth Ave., Fort Worth—Truett Kimzey, Pres., Dir.; J. W. Williams, Jr., Sec'y-Treas.

Texas Electronics Ass'n. 511 Hemphill St. Fort Worth Leonard R. Smith. Pres.; Luther Bradley, Sec'y.

Texas Electronic Technicians Ass'n., P.O. Box 15011, Houston—Ed Grange, Pres.; M. Chaplinsky, Sec'y.

(Continued on page 164)



THE express truck was just driving away from the service shop as Barney returned from his lunch hour, and the youth, who had more curiosity than Dr. Kinsey, immediately hurried inside to find out what new equipment Mac could be purchasing. The boss already had the instrument out of the box and sitting on the service bench, and he was unwrapping some small parts that had been packed with it.

"Hey!" Barney exclaimed, "that's a mighty neat looking tape recorder. Is

it for the shop?"

"Yep," Mac answered. "Our old one is pretty well worn out; furthermore, home tape recorders have improved a lot since that one was made. The features of this *Ekotape* 205 represent many of the advances found in most late model recorders."

"Such as . . ." Barney led him on.

"Such as the ability to record at either 3.75 or 7.5 inches-per-second and being able to switch instantly from one speed to the other with proper equalization of the playback amplifier being cut in automatically for either speed. It is a dual-track machine that can put two full hours of program on a seven-inch reel and has a fast forward and rewind for quickly spotting a particular section of the recording. When a program is being taped, it can be heard through the recorder speaker or this can be cut out. There is a full range tone control for boosting either the bass or highs during playback. There is a high-level input jack and a patch cord for taking a recording from any radio, TV, or phono player by simply clipping the ends of this cord directly to the voice coil connections. The same jack, of course, could be used with a shielded cord for taking the program from a high impedance source, such as directly across the volume control or from the output of a phono cartridge.

"As I mentioned, many of these features are found in practically all late model recorders; but here is something in this one that appeals to me for our uses." As he said this, Mac inserted a small device in an opening in front of the recorder and pushed it gently with his thumb. Instantly the reels that had been moving the tape through the recording head stopped going around. As his thumb released the gentle pressure, the reels started revolving again.

"This manual control of tape movement allows you to stop and start the tape instantly at any time while recording or playing back without disturbing any of the other controls. I figure it will be most handy for dictating. A fellow can say a sentence and then stop the gadget while he thinks up another."

Mac removed the hand control and inserted the end of a flexible tube that went down to a foot treadle affair resting on the floor. When he pressed on this with his foot, the tape could be stopped and started again as readily

as with the hand control.

"This foot control is a good companion for the hand control," Mac explained. "It allows you to control the recorder while your hands are busy doing something else. For example, Matilda can use it to take down on the typewriter a letter I have dictated on the tape. She can let the tape run for a few words at a time and then hold it while she puts these down, and so on."

"You whizzed something by me awhile ago," Barney complained. "What was that business about different amplifier compensation for each speed?"

"Well, you must know the response curves of an uncompensated tape recording would never serve as a high-fidelity fan's pin-up. It looks like a sort of lopsided parabola with the lows falling away from the peak more gradually than do the highs. By increasing the speed of the tape, we can increase the frequency of this peak response point. In fact, the relationship is a direct one, with the peak response frequency being doubled by doubling the tape speed."

"Hold it!" Barney commanded.

"Why?"

"Suppose we used light-sensitive tape instead of magnetic and employed a neon lamp shining through a narrow slit on to the tape as our recording head. When the light was bright, the tape in front of the slit would be turned black; when the light was out, the tape would remain white. Now if we use a low-frequency sine wave to excite the neon lamp, the moving tape will be transformed into alternate bands of white and black. As we increase the frequency of our exciting signal, the width of these bands will decrease until they become narrow vertical lines. Finally, as the frequency goes higher and higher, the alternate lines of black and white will become so narrow that they merge together. Holding our exciting frequency at this point, however, we can double the speed of the tape and so double the width of the lines, making them again easily distinguishable. Only when the exciting frequency is doubled will they merge together once more. Since the recording head prints magnetically on the tape in precisely the same way that this apparatus would print photographically, you can see why increasing the tape speed increases the potential high-frequency response.

"Yes, and I also see why different amplifier compensation would be required to flatten out the curves for each speed. You would need less highfrequency compensation at the higher

speed. Right?'

"Right," Mac applauded; "and while this picture is still fresh in your mind, perhaps we had better talk about the importance of head alignment in playing tapes recorded with a recording head that is different from the playback head. Since most home recorders use the same head to perform both jobs, this is not very important as long as the machine is used only for playing tapes recorded on that machine; but now it looks as though we are on the brink of a new era in which there will be a lot of exchanging of tapes."

"What makes you think so?"

"For one thing, it is becoming quite a fad to exchange tapes between recorder fans. In fact there is an organization called *Tape Respondents, International*, with headquarters in San Francisco, that encourages just that sort of thing. Then I saw in 'Time' a few weeks back where both *Pentron* 

(Continued on page 170)

First On The Market . . . more than 20 years ago Mallory produced the first commercial Vibrators.

First As Original Equipment . . . today Mallory produces more Vibrators for set manufacturers than all other makes combined.

First With Servicemen . . . surveys show that Mallory Vibrators are preferred and used by 5 out of 6 servicemen.

Your Work Is Right The First Time when you use Mallory Vibrators. The patented, tuned mechanism assures completely dependable performance... always. Ask for Mallory Vibrators by name.

Cover 75% of Your Replacement Needs with just 6 Mallory Vibrators!

more ways

than one!

Ask your Distributor about Mallory Deal 2448 which includes these 6 fast moving Vibrators.

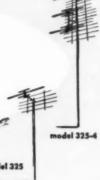
And be sure you have a copy of the current Mallory Vibrator Guide. It is a complete cross reference listing and service guide-the most recent edition of a publication serving servicemen for nearly 25 years.

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CHANNEL MASTER'S fabulous

# CHAMPION\*

the world's most powerful all-channel VHF antenna

-OUT-PERFORMS AND OUT-SELLS THEM ALL!

Never before in the history of television has an antenna received such an overwhelming reception. Channel Master's CHAMPION - in a few short months - has rocketed to the top as the nation's most-wanted, best-selling, best-performing

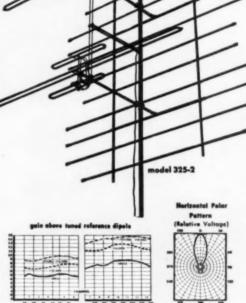
CHAMPIONSHIP Performance: Only the CHAMPION has the unique new "Tri-Pole", a triple-powered dipole system in which the Low Band dipole also functions as three dipoles tied together, in phase, on the High Band.

All-aluminum. Assembles faster than a 5-element Yagil The CHAMPION is another great contribution of the Channel Master Antenna Development Laboratories.

CHAMPIONSHIP Promotion: The CHAMPION is the antenna America knows best!

• Publicized in leading magazines! • Outstanding dealer Cooperative Advertising Program! • Free newspaper mats, window streamers and TV film commercials!





# THE STACKED CHAMPION PROVIDES:

11-13 DB High Band gain 61/2-71/2 DB Low Band gain

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325	\$20.83							
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325-4	588.89							
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WORLD'S LARGEST MANUFACTURER OF TELEVISION ANTENNAS

\*pat. pending

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# CHANNEL MASTER inter-action filters

Only Channel Master filters are permanently sealed in a block of moisture-proof, high melting-point electrical wax, locked in an attractive styrene case.

- Single lead
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Use with leads of any length!

New, specially designed High and Low Pass filters entirely eliminate the need for critical lead lengths! This new, extremely effective circuit makes the TENNA-TIE the most effective filter of its type new available.

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"Free-space" terminals.

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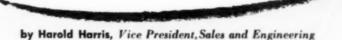
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High and Low Pass filters enable the Triple-Tie to adapt ell Hi-Lo VHF installations to UHF — quichly and effectively. "Free-Space" terminals for perfect allweather UHF reception.

new low price- \$4.86

# THE ANTENNA IN COLOR TELEVISION



Now that color telecasting is a reality, we will see an ever-increasing flow of color sets to the consumer. Although much is being said and written on the subject of color sets, many unanswered questions remain about the role of the television receiving antenna in color television.

Will present antennas work on color?

Will a special antenna be needed?

The results of thorough laboratory and field tests made by engineers of the Channel Master Antenna Development Laboratories show that practically all present TV antenna types will perform satisfactorily on color. Gain variations as high as 3 DB across one channel can be tolerated. When this figure is exceeded blurring or smearing of the picture may occur. Although there are certain antennas on the market which do have excessive gain variation, this is not the case of the vast majority of present installations.

There are also indications that fringe area color reception may be more critical.

This may necessitate the use of fringe area antennas in areas closer to the TV station.

In the nation's most advanced television research laboratory, Channel Master antennas have always been designed for full band width and minimum variation in gain on any one channel.

For this reason, every Channel Master antenna which you have installed in the past, as well as the ones you install today, will provide reception of outstanding quality when color TV comes to your area.

Channel Master antennas were the antennas selected for the tests which led to the F.C.C.'s approval of the National Television Standards Committee color system.





When it comes to high-voltage capacitors, you just can't beat CRL Precision Attachable Terminal Hi-Vo-Kaps for dependability. Here's why:

They are 100% factory-tested at twice rated working voltage — withstand continuous overload up to 40,000 v.d.c.

Terminals and taps have heavy 8-32 thread—cannot strip or break off, when terminals are tightened.

Terminals seat flat at bottom of tap. No gaps between terminals and capacitor body — no possibility of corona. Positive mechanical bond between stub terminals and internal electrodes prevents loosening, when terminals are attached.

Keep a stock of CRL Precision Attachable Terminal Hi-Vo-Kaps on hand. Separate packaging of terminals and capacitor body lets you buy only the terminals you need. See your Centralab distributor.

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# Positive WIRELESS OPERATORS OF OLD

By C. HOWARD BOWERS

OLD TIME Wireless Operators are being heard from all over the country! If you were a commercial operator around 1912, send us a brief resumé of your career as we would like to share your experiences with our readers.

This month we were privileged to hear from J. F. Hammel, Vista, California, who spun this yarn of service and adventure to his friend E. H. Marriner. "JF," as he is known to his friends, started out in San Francisco in 1912 after attending the old Marconi Wireless School.

Our new operator's first ship was a lumber schooner, the "SS Wolverton," followed by several freight and passenger vessels of the Admiral Line. Starting pay was \$30 a month plus room and board. "Board" was usually restricted to the petty officers' mess adjoining the crew's galley and "room" was that portion of the ship of least use for anything else!

Most of the West Coast operators seemed to have a yen for Alaska and "JF" was no exception as in 1913 he served aboard two lumber schooners in that area. During 1914, however, our Arctic-minded friend made his first voyage away from the U. S. coast and sailed to Chile on the "SS Cuzco" with lumber, returning with nitrates to California. In 1915 he made a European cruise on a *Grace Line* ship. He returned to the Alaska run in 1917.

"JF" continued as a wireless operator until 1937 when he fell into evil ways and became a purser. The list of ships on his service record was longer than a king size cigarette when he quit the sea in 1947 and succumbed to his dreams of a chicken ranch in southern California where he hopes they do not become cheaper by the dozen!

## Fred H. Zolin

While the majority of those engaged in professional work start as amateurs and wind up as professionals, the reverse is true in the case of Fred H. Zolin of Milwaukee. He started out as a professional telegrapher for Western Union about 1910 and did a little dabbling in wireless on the side. Fred was one of the many "boomer" operators and by 1914 he had drifted south to New Orleans and his first glimpse of the Gulf. His first sniff of salt water so stimulated his sea-going appetite that he obtained a First Class Commercial License and packed his hag and hammock.

He signed on the good ship "Alabama" bound for Frontera, Mexico. The ship had just undergone repairs and his first chore was to muck out the wireless shack. The gear was relefunken with a quenched gap—something new to our tyro "sparks." The Chief Mate had to be contacted

every time juice was wanted and no one aboard knew the ship's call. Anyway, when the rig was finally cranked up and a general call sent out, our friend promptly received a QRT from a British warship lying off Vera Cruz and what could be sweeter.

His stretches at sea were usually followed by Western Union assignments and in 1917 Fred joined the Navy as First Class Electrician's Mate and was sent to London where he served on Admiral Sims' staff in communications. After World War I he served on Herbert Hoover's American Relief Commission and held posts in Paris, Venice, Trieste, and Vienna.

Returning to the States in 1919, Fred again accepted employment with Western Union at Milwaukee, Wisconsin, where he is now assistant operations chief. He is also a big-shot amateur radio operator on the side and has served two terms as president of the Milwaukee Radio Amateur Club. This alone is no small job as the club has over 300 members. It might also be added that our friend is still going strong and that he celebrated his "39th" birthday last Christmas Day. Continued success to Fred H. Zolin.

#### John O. Ashton

Switching signals across the country, we now pick up the story of another old timer, John O. Ashton of 2261 St. Francis Drive, Palo Alto, California.

This old time wireless operator has collected more "fruit salad" than General Marshall ever thought of. It all started in (hold your hat) 1901 when "JO" and his uncle tuned in the now famous "S" signals from Marconi's colleagues in Poldu, Cornwall, in fact the same signals that Marconi and his assistants, Kemp and Paget, were receiving in Newfoundland.

During 1910 "JO" and his friend and colleague, Earl Ovington, demonstrated Professor Tesla's high-frequency apparatus at Madison Square Garden, N. Y., and during the same year he installed his counterpoise antenna on Ovingto: small Bleriot monoplane and conducted the first two-way radio communication with a plane aloft.

Our fast-moving friend obtained his "Certificate of Skill" in 1912 and became a regular operator atop 42 Broadway in New York City, Later he sailed on United Wireless equipped ships and others operated by United Fruit. He became an instructor and later an engineer in Latin America and South America. He taught radio school in four different foreign countries. He took post-graduate wireless engineering instructions in Bertin under Professor Braun, inventor of the Braun tube from whence come our TV tubes.

In 1913 he was a sales representative

RADIO & TELEVISION NEWS

for Lee DeForest in the distribution of Audion tubes. He is a member of the IRE, the National Association of Trade Executives, African Explorers Society, Pioneer Radio Station Owners, Association of Research and Development Directors, to name a few

He is now a consulting engineer and in his spare time he is preparing a series of books on the history and development of radio and electronics covered by his own experience.

Our best wishes to "JO."

THE FISHER HI-LO FILTER SYSTEM . MODEL 50-F

FOR EVERY RECORD

COLLECTOR

# Transistor Receiver

(Continued from page 73)

an input signal cause collector current to flow. This pulsating current filtered somewhat by C, operates the sensitive relay in the collector circuit. Although the class A efficiency of a junction transistor closely approaches the theoretical 50%, in this application we are interested in getting the maximum power output, irrespective of distortion, so the class B operation is much more attractive. The relay, manufactured in England, is a lightweight, sensitive device ideally suited for model airplane work. It weighs about one ounce, has a 4000-ohm winding, and operates on about 3 mw. of power. It features a balanced armature operating in the field of a permanent magnet and is highly resistant to vibration.

The sensitivity of this receiver is surprisingly good. A 40 microvolt signal, modulated 50% with a 400 cycle tone, is sufficient to operate the relay. Any signal greater than 100 microvolts will drive the last stage to saturation which delivers about 12 milliwatts into the relay. With only 3 milliwatts needed to operate the relay this gives a comfortable margin of safety.

The current drawn from the 9-volt battery is about 2 ma. for the  $V_1$  and 3 ma. each for  $V_2$  and  $V_3$ . This is a total power consumption of about 23 milliwatts under standby conditions. An incoming signal increases this drain to 50 mw. but then we are delivering 12 mw. to the relay. This is a phenomenal saving of power when we consider that most vacuum-tube receivers of this type consume at least 150 mw. of filament power alone. This receiver is normally operated from six of the smallest available flashlight batteries connected in series

A 10-watt mobile transmitter feeding into a 12-foot loaded vertical whip antenna was used for range checks. A three-foot vertical antenna was used on the receiver. Operation on the ground was satisfactory at 4 mile so the range in the air should be more than adequate.

This receiver is not offered as the ultimate for this type of service because its performance leaves much to be desired. The author hopes, however, that this description will stimulate additional activity in the use of transistors in radio receiver applica-

# FISHER **Hi-Lo Filter System**

■ Here it is at last-America's first electronic sharp cut-off Filter System. Suppresses turn-table rumble, record scratch and distortion, etc., with the absolute minimum loss of frequency response. Separate low and high frequency cut-offs. Can be used with any tuner, preamplifier, amplifier, etc. No insertion loss. Uniform response 20-20,000 cycles, ± 0.5 db. Selfpowered. All-triode. Beautiful plastic cabinet.

# **FISHER** Preamplifier-Equalizer

Now, professional record equalization facilities are within the reach of every record collector. THE FISHER Model 50-PR, like its big brother Only \$22.95 (Model 50-C) is beautifully designed and built.

THE FISHER PREAMPLIFIER-EQUALIZER . MODEL 50-PR



# OUTSTANDING **FEATURES**

· Independent switches for low-frequency turnover high frequency roll-off. • 16 combinations. • Handles any low level magnetic pickup. • Hum level 60 db below 10 mv input. • Uniform response 20-20,000 cycles, # 1 Two triode stages. • Full low frequency equalization. . Output lead any length up to 50 feet. • Beautiful plastic cabinet, etched brass control panel. • Completely shielded chassis. • Built-in AC switch. Jewel indicator light.

Write for full details

FISHER RADIO CORP. 39 EAST 47th STREET . N. Y. 



Another new, outstanding instrument design so typically characteristic of Heathkit operation in producing high quality instrument kits at the lowest possible price. A new, improved model Impedance Bridge kit featuring modern cabinet styling, with slanted panel for convenience of operation and interpretation of scales at a \$10.00 price reduction over the preceding model. Built-in adjustable phase shift oscillator and amplifier with all tubes of the battery operated type completely eliminates warm-up time. The instrument is entirely AC line operated. No bothersome battery replacements.

The Heathkit IB-2 Impedance Bridge Kit actually represents Another outstanding instrument design so typically charac

The Heathkit IB-2 Impedance Bridge Kit actually represents four instruments in one compact unit. The Wheatstone Bridge for resistance measurements, the Capacity Comparison Bridge for capacity measurements, Maxwell Bridge for low Q, and Hay Bridge for high Q inductance measurements. Read Q, D. DQ all on one dial thereby eliminating possible confusion due to the incorrect dial reference or adjustment. Only one set of instrument terminals nec-

# Features

- Simpson 100-0-100 microampere
- · Completely AC operated.
- Built-in phase shift generator and amplifier
- Battery type tubes, no warm-up required.
- Newly designed two section CRL dial
- Single knob D, Q, and DQ functions.
- Special impedance matching transformer.
- New modern cabinet styling.
- ½% precision resistors and silver mica condensers.

trement function. Panel provisions provided for external generator use.

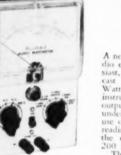
A newly designed two section CRL dial provides ten separate "units" switch settings with an accuracy of 5%. Fractions of units are read on a continuously variable calibrated wire-wound control. A special minimum capacity, shielded, balanced impedance matching transformer between the generator and the bridge. The correct impedance match is antomatically switch selected to provide constant load operation of the generator circuit. The instrument uses 12% precision resistors and condensers in all measurement circuits.

The new Heathkit IB-2 provides outstanding design features not found in any other kit instrument. The single low price includes the power supply, generator, and amplifier stages. No need to purchase instrument accessories in order to obtain the type of oper-

# Heathkit AUDIO WATTMETER KIT

MODEL AW-1 SHIPPING WT.

6 LBS.



A new Heathkit design for the audio engineer, serious hi fi enthu-siast, recording studio, or broad-Wattmeter Kit. This specialized instrument instantly indicates the output level of the equipment under test without requiring the use of external load resistors. Al readings are taken directly from the calibrated scales of a 4½"

the calibrated scales of a 4½° 200 microampere Simpson meter.

The Heathkit Audio Wattmeter features five full scale power measurement ranges from 5 milliwatts up to 50 watts with db ranges of —15 db to +48 db. The instrument has a power measurement rating of 25 watts continuous and 50 watts maximum for intermittent operation. Non-inductive resistance load impedances of 4, 8, 16, and 600 ohms are provided through a panel impedance selector switch. Frequency effect is negligible from 10 cycles to 250 kc. A conventional VTVM circuit utilizes a 12AU7 twin triode tube. The meter bridge circuit uses four germanium diodes for good line-The meter bridge circuit uses four germanium diodes for good line-

With the Heathkit AW-1 desired information can be obtained instantly and conveniently without bothering with the irksome setups and calculations usually required. Useful for power curve measurements, frequency response checks, monitoring indicator, etc. Convenient calibration directly from 110 volt AC line source. This new instrument will help to supply the answers to your audio operating or power output problems.

# Heathkit LABORATORY **GENERATOR KIT**

MODEL LG-1

SHIP, WT. 16 LBS.



new addition to the popular line of Heathkit

instruments, the Heathkit Lab-oratory Generator. Specifically designed for flexibility of operation, accuracy and versatility beyond the performance level provided by the conventional service type generator. Frequency coverage of the Colpints oscillator is 150kc to 30mc in five convenient ranges with provisions for internal or external modulation up to 50%. and .1 volt RF output throughout the frequency range. Panel mounted 200 microampere Simpson meter for RF "set refer-ence level" to provide relative indication of RF output. Individually shielded oscillator and shielded variable and step attenuator provide flexible control of RF output.

The circuit features a 6AF4 high frequency oscillator, a 6AV5 amplifier with grid modulation, 12AU7 400 cycle oscillator and modulator, OB2 voltage regulator tube, and selenium rectifier for the transformer operated power supply The smart professional instrument appearance and over-all flexibility of operation will prove a decided asset to any in-dustrial or educational laboratory. The Heathkit Laboratory Generator sets a new level of operation, far superior to any instrument in this price classification.

THE MOST Outstanding OSCILLOSCOPE IN HEATHKIT HISTORY

NEW MODEL 0-9

# OSCILLOSCOPE KI

# Check THESE FEATURES



Voltage regulated for rock steady traces—complete freedom from bounce and jitter.



Built-in 60 cycle sweep and phasing control—a necessity for TV service work.



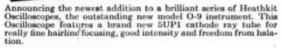
New production 5UPI CR tube by RCA gives finest trace available for complex, hard-to-see wave forms.







New ready formed and laced wiring harness eliminates unsightly and time consuming work of assembly.



#### NEW FEATURES

Efficient voltage regulation system maintains rock steady trace stabilization. New retrace blanking amplifier circuit—amplifier band width further extended through efficient circuitry. Calibrated 1 volt peak-to-peak reference — wiring simplified by ready laced and formed wiring harness—new phasing control.

# MODEL O-9

SHIPPING WT. 28 LBS.



#### GOOD DESIGN

Terminal board for quick access to deflection plates provisions for Z axis input—astigmatism control—bal-anced push-pull deflection amplifiers—internal sync on either positive or negative peaks.

#### VERTICAL AMPLIFIER

High impedance input with 6AB4 cathode follower, twin triode 12AT7 Cascade amplifier, 6C4 phase splitter and 12AT7 push-pull high gain deflection amplifier. Sensi-tivity .625 volts per inch.

## HORIZONTAL AMPLIFIER

Five position input switch for choice of external inputline sweep—line sync—internal sync and external sync. Uses 12AU7 input stage, half as triode phase splitter driving 12AT7 push-pull high gain deflection amplifier. The remaining half of the 12AU7 used as retrace blanking amplifier.

## POWER SUPPLY

New heavy duty internally shielded 100 milliampere power transformer. Efficient high voltage filtering system —voltage regulation completely eliminates trace bounce

The Heathkit O-9 is the ideal general purpose oscilloscope for educational and industrial use. Radio and TV servicing and any other application requiring the instantaneous reproduction and observation of actual wave

# Heathkit LOW CAPACITY PROBE KIT



No. 342
Oscilloscope investigation of high frequency, high impedance or broad band width circuits requires the use of a low capacity probe. The Heathkit Low Capacity Probe features a variable capacitor to provide the necessary degree of instrument impedance matching.

# Heathkit SCOPE DEMODULATOR PROBE KIT

No. 337-B \$350 SHIP. WT. 1 LB.

In applications such as trouble shooting TV, RF, If and video stages, the frequency ranges encountered require the demodulation of signals before oscilloscope presentation. The Healthit Demodulator Probe will fulfill this function and readily prove its value as a service accessory.

MODEL VC-2

SHIP. WT. 4 LBS.

Heathkit VOLTAGE CALIBRATOR KIT

The Heathkit Voltage Calibrator provides a convenient method of making peak-topeak voltage measurements with an oscilloscope. Peak-to-

with an oscilloscope. Fear-to-peak voltages are read directly on the calibrated panel scales in the range of .01 to 100 volts peak-to-peak. A convenient "signal" pos-ition on the panel switch can be used to by-pass the calibrator and apply the signal directly to the scope input.

# Heathkit ELECTRONIC SWITCH KIT

The basic function of the Heathkit S-2 Electronic Switch kit is to permit simultaneous oscilloscope observation of two separate traces which can be either separated or super-imposed for individual study. Continuously variable switching rates in three ranges from less than 10 cps to over 2000 cps. Individual gain controls for each input channel and a positioning control.



MODEL S-2

SHIP. WT. 11 LBS.



Heathkit VACUUM TUBE VOLTMETER

MODEL V-6

# Features

- ► New 1½ volt full scale low range
- 1,500 volt upper limit DC range
- Increased accuracy through 50% greater scale coverage
- High impedance 11 megohm input
- Center scale zero adjust
- Polarity reversal switch
- 1% precision resistors
- Clearly marked db scales

The beautiful Heathkit Model

the refinements developed and proven in the production of over 100,000 VTVM's. This is the basic measuring instrument for every branch of electronics. Easily meets all requirements for accuracy, stability, sensitivity, convenience of ranges, meter readability, and modern styling. It will accurately measure DC voltages, AC voltages,

modern styling. It will accurately measure DC voltages, AC voltages, offers tremendous ohmmeter range coverage, and a complete db scale for a total of 35 meter ranges.

New 1½ volt full scale low range provides well over 2½" of scale length per volt. Upper DC scale limit 1,500 volts. DC ranges 0-1.5, 5, 15, 50, 150, 500, 1,500 volts full scale. AC ranges 0-1.5, 5, 15, 50, 150, 500, 1,500 (1,000 volts maximum). Seven ohm-

meter ranges from .1 ohm to 1,000 megohms. For added convenience a DC polarity reversing switch and a center scale zero adjustment for FM alignment.

The smartly styled, compact, sturdy, formed aluminum cabinet is finished in an attractive gray crackle exterior. The beautiful two-color, durable, infra-red, baked enamel panel further adds to the over-all professional appearance.

Top quality components used throughout. 1% precision resistors—silver contact range and selector switches—selenium rectifier—transformer operated power supply. Individual calibration on both AC and DC for maximum accuracy. DB scale printed in red for easy identification, all other scales a sharp, crisp black for easy reading. A variety of accessory probes shown on this page still add further to over-all instrument usefulness.

# Heathkit 30,000 VOLT DC PROBE KIT

For TV service work or any similar application where the measurement of high DC voltage is required, the Heathkit Model 336 High Voltage Probe Kit will prove invaluable. A precision multiplier resistor mounted inside the two-color, sleek, plastic probe body provides a multiplication factor of 100 on the DC ranges of the Heathkit 11 megohm VTVM. The entire kit includes precision resistor, two-color plastic probe, tip connector spring, test lead, phone plug panel connector, and complete assembly instructions.

SHIP WT

No. 336-B



Heathkit PEAK-TO-PEAK PROBE KIT

Now read peak-to-peak voltages on the DC scales of the Heathkit 11 megohm VTVM. Readings can be directly made from the VTVM scale without involved calculations. Measurements over the frequency range of 5 kc to 5 mc. Use this probe to extend the usefulness of your VTVM in radio and TV service work. The Peak-to-Peak Probe Kit features the new polished aluminum housing with two-color polysyrene probe ends. Detailed assembly sheet including instructions for probe operation.

# Heathkit RF PROBE KIT

The Heathkit RF Probe used in conjunction with any 11 megohm VTVM will permit RF measurements up to 250 mc. ± 10%. A useful, convenient accessory for those occasions when RF measurements are desired. The RF probe body is housed in the new, martly-styled polished aluminum probe body featuring two-color polysytene probe ends and a low capacity flexible shielded test lead. The kit is complete with all necessary material and a detailed assembly sheet as well as instructions for probe operation.



No. 309-B

Heathbit AC VACUUM TUBE

# VOLTMETER KIT

MODEL AV-2

SHIPPING WT.



The new Heathkit AC VTVM that makes possible those sensithat makes possible mose sensi-tive AC measurements required by laboratories, audio enthusi-asts, and experimenters. Especi-ally useful for hum investiga-tion, sensitive null detection, phono pick-up output measure-

thono pick-up output measurements, making frequency response runs, gain measurements, ripple voltage checks, etc. Low level measurements are easy to make because of the complete voltage coverage of the instrument and the one knob operation.

The large 200 microampere Simpson meter has clearly marked and easy to read meter scales. Ten voltage ranges covering from .01 rms full scale to 300 volts rms full scale, with frequency response ± 1 db from 20 cycles to 50,000 cycles to the province of cycles. Instrument input impedance I megohm, ten db ranges from -52 db to +52 db. For stability and good linearity characteristics the meter bridge circuit features 4 germanium diodes. Attractive instrument styling, a companion piece for the popular Heathkit VTVM and the new AW-1 Audio

- 20,000 ohms per volt DC sensitivity, 5,000 ohms per volt on AC
- Polarity reversal switch
- 1% precision multiplier resistors
- 50 microampere 412" Simpson meter
- Meter ranges for service convenience
- Mew resistor ring-switch assembly
- ✓ Total of 35 meter ranges
- Wew Modern cabinet styling

NEW Heathbit MULTIMETER The most important Heathkit announcement of the year, the

ohms x 1 x 1,000 x 10,000, DB coverage from -10 db to 4-65 db.

new 20,000 ohms per volt Heathkit Multimeter, Model MM-1. The universal service measuring instrument, accurate, sensitive, portable, and completely independent of AC line supply. Particularly designed for service use incorporating many desirable features for the convenience of the service man. Full 20,000 ohms per volt sensitivity on DC ranges - 5,000 ohms per volt sensitivity on AC-polarity reversal switch, no bothersome transferring of test leads - 1% precision multiplier resistors - large 41/2" recessed non-glare 50 microampre Simpson me-

ter - conveniently slanted control panel - recessed safety type banana jacks - standard universally available batteries rugged practical sized cabinet with plastic carrying handle, and a total of 35 calibrated meter ranges.

RANGES

Voltage ranges selected entirely for service convenience. For example 11/2 volt full scale low range for measuring portable radio filament voltages, bias voltages, etc., 150 volt full scale range for AC-DC service work, 500 volt full scale range for conventional transformer operated power supply systems. Complete voltage ranges AC and DC, 0-1.5-5-50-150-500-1,500-5,000 volts. DC current ranges, 0-150 microamperes-15 milliamperes-150 milliamperes-500 milliamperes-15 amperes. Resistance measurements from .2 ohms to 20 meg-

#### CONSTRUCTION

Entirely new design permits assembly, mounting and wiring of precision resistors on a ring-switch assembly unit. The major portion of instrument wiring is completed before mounting the ring-switch assembly to the panel. No calibration procedure is required, all precision resistors readily accessible in event of replacement.

#### CABINET

Strikingly modern cabinet styling featuring two piece construction, durable black Bakelite cabinet, with easy to read panel designations. Cabinet size 51/5" wide x 4" deep x 71/5" high, Good cabinet physical stability when operated in vertical position.

The Heathkit MM-1 represents a terrific instrument value for a high quality 20,000 ohms per volt unit using all 1% deposited carbon type precision resistors. Here is quality, performance, functional design, and attractive appearance, all combined in one low priced package.

# Heathbit BATTERY TESTER KIT



2 LBS

The Heathkit Battery Tester measures all types of dry batteries between 11/2 volts and 150 volts under actual load conditions. Readings are made directly on a three color Good-Weak-Replace scale. Operation is extremely simple and merely requires that the test leads be connected to the battery under test. Only one control

to adjust in addition to a panel switch for "A" or "B" battery types. The Heathkit Battery Tester features compact assembly, accurate meter movement, and a three deck wire-wound control, all mounted in a portable rugged plastic cabinet. Checks portable radio batteries, hearing aid batteries, lantern batteries, etc.

# Heathkit HANDITESTER KIT



SHIPPING WT.

3 LBS.

The Heathkit Model M-1 Handitester readily fulfills major requirements for a compact, portable volt ohm milliammeter. Despite its compact size, the Handitester is packed with every desirable feature required in an instrument of this type. AC or DC voltage ranges full scale, 0.10—30—300—1,000—5,000 volts. Two ohmmeter ranges, 0-3,000 and 0-300,000, Two DC current measurement ranges, 0.10 milli-amperes and 0.100 milliamperes. The instruamperes and 0-100 milliamperes. The instru-ment uses a Simpson 400 microampere meter movement, which is shunted with resistors to provide a uniform 1 milliampere load on both AC and DC ranges. Special type, easily access-ible, battery mounting bracket — 1% deposited carbon type precision resistors — hearing aid type ohms adjust control. The Handiester is easily assembled from complete instructions and pictorial diagrams. Necessary test leads are in-cluded in the price of this popular kir. cluded in the price of this popular kit.



- ₩ Either 6 or 12 volt operation
- Continuously variable voltage output
- Constant ammeter and voltmeter monitoring
- Automatic overload relay selfresetting
- Two 10,000 mf condensers
- New 18 disc split type heavy duty rectifier unit
- Fuse protection

Here is the new Heathkit Battery Eliminator necessary for modern, up-to-date operation of your service shop. The Heathkit Model BE-4 furnishes either 6 volts or 12 volts output which can be selected at the flick of a panel switch. Use the BE-4 to service the new 12 volt car radios in addition to the conventional 6 volt radios.

This new Battery Eliminator provides two continuously variable output ranges, 0-8 volts DC at 10 amperes continuously, or 15 amperes maximum intermittent; 0-16 volts DC at 5 amperes continuously or 7.5 amperes maximum intermittent. The output voltage is clean and well filtered as the circuit uses two 10,000 mf condensers. The continuously variable voltage output feature is a definite aid in determining the starting point of vibrators, the voltage operating range of oscillator circuits, etc. Panel mounted meters constantly monitor voltage and cur-

rent output and will quickly indicate the presence of a major circuit fault in the equipment under test. The power transformer primary winding is fuse protected and for additional safety an automatic relay of the self-resetting type is incorporated in the DC output circuit. The heavy duty rectifier is a split type 18 plate magnesium copper sulfide unit used either as a full wave rectifier or voltage doubler according to the position of the panel range switch.

Here is the ideal battery eliminator for all of your service problems and as an additional feature, it can also be used as a battery charger. Another new application for the Heathkit Battery Eliminator is a variable source of DC filament supply in audio development and research. More than adequate variable voltage and current range for normal applications.

# Heathkit VIBRATOR TESTER KIT

Your repair time is valuable, and service use of the Heathkit Vibrator Tester will save you many hours of work. This tester will instantly tell you the condition of the vibrator being checked. Checks vibrators for proper starting and the easy to read proper starting and the easy to read meter indicates quality of output on a large Bad-?-Good scale. The Heath-kit VT-1 checks both interrupter and self rectifier types of vibrators. Five different sockers for checking hundreds of vibrator

The Heathkit Vibrator Tester operates from any battery eliminator capable of delivering continuously variable voltage from 4 to 6 volts DC at 4 amperes. The new Heathkit Model BE-4 Battery Eliminator would be an ideal source of supply.



SHIPPING WT. 6 LBS.

# NEW Heathkit VARIABLE

# ISOLATION TRANSFORMER KIT

The new Heathkit Isolation Transformer Kit provides line isolation for AC-DC radios (not an auto transformer), thereby eliminating shock hazard, hum problems, alignment difficulties, etc. The output voltage is variable from 90 to 130 volts AC and is constantly monitored by a panel mounted AC volt meter. Use it to increase AC supply voltage in order to induce breakdown of faulty components in circuits thereby saving service time. Use it also to simulate varying line voltage conditions and to determine the line voltage level at which oscillator circuits cease functioning, particularly in three-way portable radios. Rated at 100 watts continuous operation and up to 200 watts maximum intermitand up to 200 watts maximum intermit-tent operation. A useful radio and TV service tool.



MODEL IT-1

650

SHIP. WT. 9 LBS.



# Heathkit

Binding post kit now available so that standardization of all instrument connectors is possible. This new, five-way binding post will accommodate an alligator clip, banana plug, test lead pin, spade lug, or hook-up wire. Sold in units of 20 binding post assembles. Each assembly includes binding post, flat and shoulder fiber washers, solder lug, and nut. 120 pieces in all. Kit 362, \$4.00.



# Heathkit TECHNICAL APPLICATION BULLETINS

An exclusive Heathkit service. Technical application bulletins prepared by recognized instrument authorities outlining various combining various by recognized instrument authori-ties outlining various combinations of instrument applications. Avail-able now with 40 four-page illus-trated bulletins and an attractive flexible loose-leaf binder. Only \$2.00. (No c.o.d. on this item, please.)

- INCREDUCTOR controllable inductor
- ✓ TV and IF sweep deviation 12-30 mc
- 4 mc- 220 mc continuous frequency coverage
- Oscillator operation entirely on fundamentals
- Output in excess of 100,000 microvolts
- Automatic amplitude circuit
- Voltage regulation

Simplified operation Proudly announcing an entirely new advanced model TV and FM Sweep Generator, the Heathkit Model TS-3. This new design prosweep Generator, the releating moster 13-3. Ins new design provides features and combinations of functions not found in any other service type instrument. Every design consideration has been given to the requirements of the TV service man to provide a flexible, variable sweep source with more than adequate RF output and complete frequency coverage throughout the TV and FM

The frequency range of the TS-3 is from 4 mc to 220 mc in four switch selected ranges. All frequency ranges are overlapping for complete coverage. A particularly important feature of the instrucomplete coverage. A particularly important reading on elisation ment is that the oscillator operates entirely on fundamentals, thereby providing complete freedom from spurious oscillation and parasities normally encountered in beat frequency type oscillators. This circuity assures a much higher total RF output level and

simplifies attenuation problems.

The new TS-3 features an entirely new principle of sweep operation. Sweep action is entirely electronic with no moving parts or electro-mechanical devices so commonly used. The heart of the sweep system is a newly-developed INCREDUCTOR controllable inductor. With this system, the value of inductance of each oscil-

NEW Heathkit TV ALIGNMENT **GENERATOR** MODEL TS-3 \$**AA**50 SHIPPING WEIGHT IS POUNDS

> lator coil is electrically varied with an AC control current, and the inductance variation is achieved by a change in the magnetic state of the core on which the oscillator coils are wound. This system provides a sweep deviation of not less than 12 mc on all TV frequencies, and up to a maximum of 30 mc on TV IF frequencies. The high RF output level throughout the instrument frequency range overcomes the most common complaint of the older type sweep generators. A new, automatic amplitude control circuit maintains the output level flat to ± 2 db throughout the instrument range. For convenience of operation a low impedance

instrument range. For convenience of operation a low impedance 50 ohm output is used.

Operation of the instrument has been simplified through the reduction of panel controls and separate panel terminals provide for external synchronization if desired. The circuit uses 1 voltage regulator tube to maintain stable instrument operation. A built-in variable oscillator marker further adds to flexibility of instrument operation. Provisions are also made for the use of an external marker, such as your service type signal generator, if desired. Use the Heathkit TS-3 for rapid, accurate TV alignment work, and let it help you solve those time consuming, irksome problems so frequently encountered.

# NEW Heathkit SIGNAL GENERATOR KIT



MODEL SG-8

**0**50

SHIPPING WEIGHT 8 POUNDS

Announcing the new Heathkit Model SG-8 service type Signal Generator, incorporating many design features not usually found in an instrument in this price range. The RF output is from 160 kc to 100 mc in five ranges, all on fundamentals, with useful harmonics up to 200 mc. The RF output law in the price of 100,000 prices also the property of 100,000 prices also throughout the

put level is in excess of 100,000 microvolts throughout the frequency range.

frequency range.

The oscillator circuit consists of a 12AT7 twin triode tube.
One half is used as a Colpitts oscillator, and the other half as a cathode follower output which acts as a buffer between the oscillator and external load. This circuity eliminates oscillator frequency shift usually caused by external circuit

All coils are factory wound and adjusted, thereby com-pletely eliminating the need for calibration and the use of additional calibrating equipment. The stable low impedance output features a step and variable attenuator for complete control of RF level. A 6C4 triode acts as a 400 cycle sine wave oscillator and a panel switching system permits a choice of either external or internal modu-

The transformer operated circuit is easy to assemble, requires no calibration, and meets every service require-ment for an adjustable level variable frequency signal source, either modulated or un-modulated.

# NEW Heathkit BAR GENERATOR KIT



s1450

SHIPPING WEIGHT 6 POUNDS

The Heathkit BG-1 Bar Generator represents another welcome addition to the fast growing line of popular Heathkits. The

station transmitted test pattern is rapidly disappearing, and the bar generator is the logical answer to the TV service man's problem in obtaining quick, accurate adjustment information without waiting for test patterns.

The Heathkit BG-1 produces a series of horizontal or vertical bars on a TV screen. Since these bars are equally spaced, they will quickly indicate picture linearity of the receiver under test. Panel switch provides "stand-by position" — "horizontal position" vertical position." The oscillator unit utilizes a 12AT7 twin triode for the RF oscillator and video carrier frequencies. A neon relaxation oscillator provides low frequency for vertical linearity tests. The instrument will not only produce bar patterns but will also provide an indication of horizontal and vertical sync circuit stability, as well as overall picture size.

Instrument operation is extremely simple, and merely requires connection to the TV receiver antenna terminal. The unit is transformer operated for safety when used in conjunction with universal or transformerless type TV circuits.



drive and illumination of roll chart. instrument is primarily designed for the convenience of the radio and TV service man and will check the operating quality of tubes commonly encountered in this type of work. Test set-up procedure is simplified, rapid, and flexible. Panel sockets accommodate 4, 5, 6, and 7 pin tubes, octal and loctal, 7 and 9 pin miniatures, 5 pin Hytron and a blank socket for new tubes. Built-in neon short indicator, individual three-position lever switch for each tube element, spring return test switch, 14 filament voltage ranges, and line set control to compensate for supply voltage variations, all represent important design features of the TC-2. Results of tube tests are read directly from a large  $4\frac{1}{2}$  Simpson three-color meter, calibrated in terms of Bad-?-Good. Information that your customer can readily understand. Checks emission, shorted elements,

open elements, and continuity.

The use of closer tolerance resistors in critical circuits assures correct test information and eliminates the possibility of inaccurate test interpretation. Improvement has been made in the mechanical roll chart drive system, completely eliminating diagonal running, erratic operation, and backlash. The thumb wheel gear driven action is smooth, positive, and free running. As an additional feature, the roll chart is illuminated for easier reading, particularly when the tube checker is used on radio or TV home service calls.

Wiring procedure has been simplified through the extended use of multicable, color coded wires, providing a harness type installation between tube sockets and lever switches. This procedure insures standard assembly and imparts that "factory built" appearance to instrument construction. Completely detailed information is furnished in the new step-by-step construction manual, regarding the set-up procedure for testing of new or unlisted tube types. No

delay necessary for release of factory data.

The new Heathkit Tube Checker will prove its value in building service prestige through usefulness—simplified operation—attractive professional appearance. Don't overlook the fact that the kit price represents a savings of \$40.00 to \$50.00 over the price of a comparable commercially built instrument. At this low price, no service man need be without the advantages offered by the Heathkit Tube Checker.

# CHECK THESE NEW Features

- Simplified harness wiring
- Improved, smooth, anti-backlash roll chart action
- Optional roll chart illumination
- Individual element switches
- Portable or counter style cabinet
- Spare blank socket
- Contact type pilot light test socket
- Simplified test set-up procedure
- Line adjust control
- 41/2" three-color meter



The portable model is sup-

The portable model is sup-plied with a strikingly at-tractive two-tone cabinet finished in rich maroon, proxy-lin impregnated, fabric covering with a contrasting gray on the inside cover. Detachable cover, brass-plated hardware, sturdy plastic handle help to impart a truly professional appearance to the instrument.

PORTABLE TUBE CHECKER CABINET as described above will fit all earlier Heathkit TC-1 Tube Checkers. Shipping weight 7 lbs. Cabinet only, 91-8, \$7.50.



1 Lb.

# Heathkit TV PICTURE TUBE TEST ADAPTER

The Heathkit TV Picture Tube Test Adapter used with the Heathkit Tube Checker will quickly check for emission, shorts, etc., and de-termine picture tube quality. Con-sists of standard 12 pin TV tube socker, four feet of cable, octal socket connector, and data sheet.

# Heathkit POWER SUPPLY KIT



SHIPPING WT. 17 LBS.

The Heathkit Laboratory Power Supply features continuously variable, regulated voltage output with good stability under wide load variations. A 41/2" Simpson plastic enclosed panel mounted meter provides accurate meter output information of voltage or current. All panel terminals completely isolated from the cabinet. Separate 6.3 volt AC supply at 4 amperes for filament requirements. Ripple component exceptionally low, stand-by switch provided to eliminate warm-up time of the five tube circuit.

# LABORATORY AND SERVICE SHOP BOOKLETS

"Planning Your Service Business" by John T. Frye, and "Establishing the Industrial Electronics Laboratory" by Louis B. Garner, Jr., are booklets available to Heath-kit customers at no charge. These booklets, written by nationally recognized authorities, outline the various requirements and considerations for establishing your own service business or for setting up an industrial electronics laboratory. Full attention is given to various details that are frequently overlooked when projects of this nature are undertaken. Just write in to the Heath Company requesting your free copy, or attach a memo to your next order.

- Visual and aural signal tracing
- I'wo channel input
- High RF sensitivity
- Unique noise locater circuit
- Calibrated wattmeter
- Substitution test speaker
- Utility amplifier
- RF, audio probes and test leads included



An entirely new type of signal tracer incorporating a combina-tion of features not found in any other instrument. Designed ex-pressly for the radio and TV service man, particularly for the servicing of AM, FM, and TV circuits. Here in a five tube, trans-former operated instrument are all of the useful functions so necessary for speedy, accurate isolation of service difficulty. This new signal tracer features a special high gain RF input channel, used in conjunction with a newly-designed wide frequency range demodulator probe. High RF sensitivity permits signal

tracing at the receiver antenna input. A separate low gain channel and probe available for audio circuit exploration. Both input channels are constantly monitored by an electron ray beam indicator, so that visual as well as aural signal indications may be observed. The instrument can also be used for comparative estimation of gain per stage.

A decidedly unusual feature is a noise localizer circuit in conjunction with the audio probe. With this system, a DC potential is applied to a suspected circuit component and the action of the

voltage in the component can be seen as well as heard. Invaluable for ferreting out noisy or intermittent condensers, noisy resistors, controls, coils, IF and power transformers, etc. A built-in calibrated wattmeter circuit is very useful for a quick preliminary check of the total wattage consumption of the equipment under test. Separate panel terminals provide external use of the speaker or output transformer for substitution purposes. Saves valuable service time by eliminating the necessity for speaker removal on every service job. The terminals also permit the utilization of other shop equipment, such as your oscilloscope of VTVM. The T-3 Signal Tracer can be used as a high gain amplifier for checking tuners, record changers, microphones, phono voltage in the component can be seen amplifier for checking tuners, record changers, microphones, phono

Don't ov Crystals, etc.

Don't overlook the interesting service possibilities provided through the use of this new instrument and let it work for you by saving time and money. The kit is supplied complete with all tubes, circuit components, demodulator probe, audio probe, and additional test leads.

# Heathkit DECADE RESISTANCE KIT

MODEL DR-1 The Decade Resistance Kit provides individual switch selection of resistance values using twenty 1% resistors providing a choice of 1 to 99,999 ohms in 1 ohm steps. Ceramic wafer switches, silverplated contacts, smooth, positive detent action, baked enamel panel, and handsome, polished birch cabinet.

# Heathkit DECADE CONDENSER KIT

The Heathkit Decade Condenser Kit MODEL DC-1 features silver mica, precision condensers with a rated accuracy of # \$1650 densers with a rated accuracy of ± 1%. Capacity values are arranged in three decades from 100 mm for .111 mf in steps of 100 mm f. Ceramic wafer switches with silver-plated contacts and smooth detent action. Useful in laboratory work, for circuit development.

\$1650



# Heathkit RESISTANCE SUBSTITUTION BOX KIT



The Heathkit Resistance Substitution Box provides individual switch selection of any one of 36 RTMA 1 wat 10% standard value resistors, wit. anging from 15 ohms to 10 meghoms. Many applications in circuit development work, and also in radio and TV service work leal for experimentally determining resistance values and for quickly altering circuit operating characteristics. Entire unit housed in attractive Bakelite cabinet, featuring the new universal type Heathkit binding posts to simplify circuit connections. circuit connection

# Heathkit CONDENSER CHECKER KIT



SHIPPING WT. 8 POUNDS

Use the Heathkit C-3 Condenser Checker to quickly and accurately measure those unknown condenser and resistor values. All readings are taken direct-

ly from the calibrated panel scales without re-quiring any involved calculation. Capacity meas-

urements in four ranges from .00001 mf to 1,000 mf. Checks paper, mica, ceramic, and electrolytic condensers. A power factor control is available for accurate indication of electrolytic condenser measurements. A leakage test switch with switch selection of five polarizing voltages, 25 volts to 450 volts DC, will indicate condenser operating quality under actual load condition. The spring return leakage test switch automatically discharges the condenser under test and eliminates shock hazard to the operator. hazard to the operator.

Resistance measurements can be made in the range from 100 ohms to 5 megohms. Here again all values are read directly on the calibrated scale. Increased circuit sensitivity coupled with an electron beam null indicator increases overall instrument usefulness.

and tator increases overall instrument userumess. For safety of operation the circuit is entirely transformer operated and the instrument is housed in the attractive, newly-styled Heathkit cabinet, featuring rounded corners, and drawn aluminum panel. The outstanding low kit price for this surprisingly accurate instrument includes necessary test leads. Good service shop operation requires the use of this specialized instrument, designed for the express purpose of determining unknown condenser values and operating characteristics.



# CHECK THESE

# NEW Features

- Single knob band switching
- Pre-wound coils
- Metered operation
- 52 ohm coaxial output
- Crystal or VFO excitation
- Built-in power supply
- Rugged, clean construction

Here is the latest Heathkit addition to the ham radio field, the AT-1 Transmitter Kit, incorporating many desirable design features at the lowest possible dollar-per-warts price. Panel mounted crystal socket, stand-by switch, key click filter, AC line filtering, good shielding, etc. VFO or crystal excitation—up to 35 watts input. Built-in power supply provides 425 volts at 100 ma. This kit features pre-wound coils, single knob band switching, 52 ohm coaxial output, plug in chassis provisions for VFO or modulator and rugged clean construction. Frequency range 80, 40, 20,

15, 11, and 10 meters. Tube line-up 6AG7 oscillator-multiplier, 6L6 ampliner-doubler, 5U4G rectifier. Physical dimensions 8½ high x 13½" wide x 7" deep. This amazingly low kit price includes all circuit components,

tubes, cabinet, punched chassis, and detailed construction manual.

The ideal kit for the novice just breaking into ham radio. It can be used later on as a stand-by rig or an all band exciter for higher powered transmitter.

# NEW Heathkit ANTENNA COUPLER KIT

New Heathkit Antenna Coupler, specially designed for the Heathkit AT-1 Transmitter. The Antenna Coupler can be used with any 52 often coatal input—up to 75 warts power. Low pass filter with cut-off frequency of approximately 36 mc — L section tuning network—neon tuning indicator — rugged, compact construction tuning network—neon tuning indi-cator—rugged, compact construction— transmitter type variable condenser, and high Q coil are all ourstanding features. The AC-1 has both inductance and capa-city tuning for maximum operating versa-tility. Dimensions 8½" wide x 4½" high x 4½" deep.



MODEL AC-1 \$1 A 50 SHIP. WT.

3 LBS.

# Heathkit ANTENNA IMPEDANCE METER

Use the Heathkit Antenna Impedance Meter for measuring antenna impedance for line matching purposes — adjustment of beam antennas — phone montrot, etc. It will determine antenna resistance at resonance, match transmission line for minimum SWR, determine receiver input impedance, and provide a rough indication of SWR. Precision resistors, germanium diode, 100 microampere Simpson meter. Dial calibrated from 0-500 ohms. Shielded aluminum calinet. 7" Shilp, WT. 3 LBS.



MODEL AM-1

# Heathkit COMMUNICATIONS RECEIVER KIT

MODEL AR-2 \$2550 SHIP, WT.

Here is the new receiver kit you have repeatedly asked for, the Heathkit Communications Receiver. The perfect companion piece for the AT-1 Transmitter kit. Many outstandingly desirable features have been incorporated in the design of the AR-2; such as, electrical bandspread transformers for high sensitivity and good signal to noise ratio—separate RF gain control with optional automatic volume control or manual volume control, in addition to the conventional audio gain control. Noise limiter—stand-by switch—stable BFO oscillator circuit—headphone jack—transformer operation, etc., all contribute to a high performance standard.

Frequency coverage is continuous from 535 kg to 35

Frequency coverage is continuous from 535 kc to 35 mc in four ranges. For added convenience, various ham hands have been separately identified in respect to their relative placement on the slide rule tuning scale. A chassis mounted, 5½° PM speaker is included with this kit. Tube line up 12BE6 mixer oscillator, 12BA6 IF amplifier, 12AV6 detector AVC audio, 12BA6 BFO oscillator, 12A6 beam power output, 533GT restifier.

Proxylin impregnated, fabric covered, plywood cabinet with aluminum panel designed expressly for the AR-2 Receiver. Part 91-10, shipping weight 5 lbs., \$4.50.

# IMPROVED Heathkit GRID DIP METER KIT \$1950 SHIP. WT.

MODEL GD-18

The invaluable instrument for service men, hams, and experimenters. Useful in TV service work for alignment of traps, filters, IF stages,

of traps, filters, IF stages, peaking compensation networks, etc. Locates spurious oscillation, provides a relative indication of power in transmitter stages, use it for neutralization, locating parasitics, correcting TVI, measuring C, L, and Q of components, and determining RF circuit resonant frequencies. With oscillator energized, useful for finding resonant frequency of tuned circuits. With the oscillator not energized, the instrument acts as an absorption wave meter. Variable meter sensitivity control, head phone jack, 500 microampere Simpson meter. Continuous frequency coverage from 2 mc to 250 mc. Pre-wound coil kit and rack, new three prong coil mounting. 6AF4 high frequency triode.

Two additional plug-in coils are available and provide continuous extension of low frequency coverage down to 355 kc. Dial correlation curves included. Shipping weight 1 lb., kit 341, \$3.00.



- First popular priced Q Meter
- P Reads Q directly on calibrated scale
- Oscillator supplies RF frequencies of 150 kc to 18 mc
- Calibrate capacitor with range of 40 mmf to 450 mmf with vernier of ± 3 mmf
- Measures Q of condensers, RF resistance, and distributed capacity of coils
- Many applications in design and development work
- Useful in TV service work for checking deflection yokes, coils, chokes, etc.

Another outstanding example of successful Heathkit engineering effort in producing a Q Meter Kit within the price range of TV service men, schools, laboratories, and experimenters. This Q Meter meets RF design requirements for rapid, accurate measurement of capacity, inductance, and Q at the operating frequency and all indications of value can be read directly on the meter calibrated scales, Oscillator section supplies RF fre-



quencies of 150 kc to 18 mc, Calibrate capacitor with range of 40 mmf to 450 mmf, with vernier of ± 3 mmf.

Particularly useful in TV service work for checking peaking coils, wave traps, chokes, deflection coils, width and linearity coils, etc. At this low kit price research laboratory facilities are within the range of service shops, schools, and experimenters.

# Heathkit INTERMODULATION ANALYZER KIT



MODEL IM-1

\$3950

SHIPPING WT.

The Heathkit IM-1 is an extremely versatile instrument specifically designed for measuring the degree of inter-action between two signals in any portion of an audio chain. It is primarily intended for making tests of audio amplifiers, but may be used in other applications, such as checking microphones, records, recording equipment, phonograph pick-ups, and loud-speakers. High and low test frequency source, intermodulation unit, power supply, and AC vacuum tube volt meter all in one complete instrument. Per cent intermodulation is directly read on the calibrated scales, 30%, 10%, and 3% full scale. Both 4:1 and 1:1 ratios of low to high frequency easily set up. With this instrument the performance level of present equipment, or newly developed equipment can be easily and accurately checked. At this low price, you can now enjoy the benefits of intermodulation analysis for accurate audio interpretation.

# Heathkit AUDIO GENERATOR KIT

A Heathkit Audio Generator with frequency overage from 20 cycles to 1 mc. Response flat ± 1 db from 20 cycles to 400 kc, down 3 db at 600 kc, and down only 8 db at 1 mc. Calibrated, continuously variable, and step attenuator output controls provide convenient reference output level. Distortion is less than 4% from 100 qps through the audible range. The ideal controllable extended frequency sine wave source for audio circuit investigation and development.



Heathkit AUDIO OSCILLATOR KIT

Sine or square wave coverage from 20 to 20,000 cycles in three ranges at a controllable output level up to 10 volts. Low distortion, 1% precision resistors in multiplier circuits, high level output across entire frequency range, etc., readily qualify this instrument for audio experimentation and development work. Special circuit design consideration features thermistor operation for good control of linearity.



\$2450

# Heathkit AUDIO FREQUENCY METER KIT



MODEL AF-1

SHIP. WT. 12 LBS. son 4½" meter.

The Heathkit Audio Frequency Meter provides a simple and convenient means of checking unknown audio frequencies from 10 cycles to 100 kc at any voltage level between 3 and 500 volts rms with any non-critical wave shape.

Instrument operation is entirely electronic. Just set the range switch, feed an unknown frequency into the instrument, and read the frequency directly on the calibrated scale of the Simp-

# Heathkit SOUARE WAVE GENERATOR KIT



MODEL SQ-1

SHIP. WT. 12 LBS.

The Heathkit Square Wave Generator provides an excellent square wave frequency source with completely variable coverage from 10 cycles to 100 kc. This generator features low output impedance of 600 ohms and the output voltage is continuously variable between 0 and 20 volts, thereby providing the necessary degree of operating flexibility. An invaluable instrument for those specialized circuit investigations requiring a good, stable, variable square wave source.



When selecting an amplifier for the heart of your high fidelity audio system, investigate the outstanding advantages offered by the Heathkit Williamson Type Amplifier. Meets every high fidelity audio requirement and makes Intening to recorded music a thrilling new experience.

This outstanding amplifier is offered with optional output transformer

#### PRICES OF COMBINATIONS

W-2 Amplifier Kit including main amplifier, power supply, and WA - P1 Preamplifier Kit.
Shipping Weight 37 lbs. Shipped Express only.

W-2M Amplifier Kit includes \$ main amplifier and power \$ supply. Shipping Weight 29 lbs. Shipped Express only.

WA-P1 Preamplifier Kit only. \$
Shipping Weight 6 lbs. Shipped Express or Parcel Post.

operation, providing either the conventional triode output circuit or the new extended power circuity in which the screen supply voltage is obtained from separate transformer primary taps. Frequency response within ±1 db from 10 cycles to 100 kc. Tube complement — 6SN7 cascade amplifier and phase splitter. 6SN7 push pull driver, two 5881 push pull power amplifiers, one 5V4G cathode type rectifier.

Matching preamplifier available providing three switch selected inputs, correct compensation, and individual bass and treble tone controls. Uses 12AV? (or 12AX7) preamplifier — 12AU? tone control amplifier.

Particularly designed for the novice kit builder and requires no specialized knowledge or equipment for successful assembly and operation.

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A new 20 watt high fidelity amplifier, designed especially for custom audio instal-lations demanding clean reproduction, ade-quate power, and flexibility to meet indi-yidual requirements. Separate treble and

vidual requirements. Separate treble and bass tone controls provide up to 15 db boost or cut. Four switch selected inputs, each with the necessary compensation for the service desired. Output transformer impedances of 4.8, and 16 ohms.

Preamplifier, tone control, and phase splitter circuits utilize 9 pin twin triode miniature tubes for low hum and noise level. Two 6L6 push pull power output to 126 (at 3 db below rated output). Tube line-up: 12AX7 premplifier, 12AU7 voltage amplifier and tone control, 12AU7 voltage amplifier and phase splitter, two 6L6 push pull pentode power output, 5U4G rectifier. Truly outstanding amplifier performance coupled with low eost. pled with low cost.

# Heathkit ECONOMY 6 WATT AMPLIFIER KIT



The new Heathkir Model A-7B Amplifier offers many unusually fine features not normally expected in this low price range. Either of the two input circuits may be individually switch selected for phono or tuner operation. Separate bass and treble tone controls. Output impedances of 4, 8, and 15 ohms. Push pull beam power output stage for balanced pull beam power output. 12/5 amplifier, 12/8L7 second amplifier and phase splitter, two 12/8G watts power output. 12/95 amplifier, 12/8L7 second amplifier and phase splitter, two 12/8G beam power output, one 5YS GT rectifier. A-7C incorporates preamplifier stage with special compensated network output level phono cartridge, Circuit is properly compensated for microphone operation. \$17.50.

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# Heathkit

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# Let's Look at Changers

(Continued from page 57)

being activated, then determine what mechanical part is binding or not operating, causing failure to trip. On the Phileo, first see if the weighted cam is dropping to engage the main gear when the trip finger releases it.

Close observation and patience are needed when service is required in the trip and reject system. Each changer is different and has to be approached from a different view. When it is known what the particular record changer is supposed to do, it is not hard to find out what it is not doing.

## The Record Drop

Modern record changers use a record drop. The records rest on a record support and centerpost or just on the centerpost itself. The bottom record slides down the centerpost when it is needed. Older changers either used two record supports, slid the records off a stack on the turntable, turned them over, or used other various combinations; but the modern method is much easier on the records, quicker, and simpler.

In modern changers, the records are either pushed off or pulled off. For example, the Zenith record changer has a little finger, called an ejector cam, that slides up into the center hole of the record and rotates outward pulling the record off the rest on the centerpost (see Fig. 7C). To service a record dropping failure on this changer, check the ejector cam to see if it enters the center hole properly and rotates far enough to pull the record off. From there, check the ejector lever and link assembly under the turntable that causes the ejector cam to move.

On a Webcor changer, a different approach is necessary, for in this changer the records are pushed off the spindle. The record support shelf moves forward and pushes the bottom record off the centerpost rest (see Fig. 7A). If the records are not pushed off properly, the trouble is in the record support shelf. It may be turned so that the record does not rest on it evenly, or perhaps the rocker arm assembly needs adjustment or service to move the record shelf forward or backward to make the record fit.

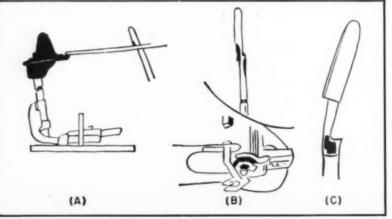
On the V-M record changer, still another method is used. Here the records rest entirely upon the centerpost. The record support is used merely to balance the records in position. An ejector cam reaches out of the centerpost and pushes the bottom record off the shelf on which the records rest. See Fig. 7B. Check for a bent centerpost or perhaps a worn ejector cam if record dropping troubles develop in this changer.

The RCA 45 rpm record changer uses an entirely different type of record drop than any of the other changers described before. A set of separator knives and record shelves is mounted in the large diameter centerpost of the changer. The knives are located one record thickness above the shelves. At the start of the record drop operation, the shelves are moved out of the centerpost, underneath the record stack, and the knives are moved in to allow one record to drop on the shelves. Then, the knives are moved out, to hold up the rest of the records. and the shelves move in to drop the single record on the turntable. All of this is accomplished by the centerpost rotation about a separator shaft with flat surfaces.

This article has described briefly the most important parts of a record changer. The motor turns the turntable, the record plays, it trips, and the change cycle brings the tone arm out of the way while a new record drops and the tone arm comes to rest on the new record. Sounds simple, doesn't it? Well, record changer servicing is fairly simple if attention is focused on the section needing service, and not on the maze of gears, levers, springs, etc.

Future articles will cover detailed field and bench service on all late model record changers.

Fig. 7. Three popular record drop mechanisms. In (A), the record support shelf does the pushing, in (B) and (C), the centerpost does the dropping.





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# **Manufacturers**

The bulletins reviewed in this section are for your convenience; unless otherwise indicated they are available to all our readers. For prompt attention write directly to the manufacturer for literature described.

#### TUBES AND ACCESSORIES

Amperex Electronic Corporation, 230 Duffy Ave., Hicksville, N. Y., has released a "library reference edition" of its complete catalogue.

Prepared for the benefit of engineers, the new publication provides a permanent and easy reference-record of every electronic tube and tube accessory manufactured by the company for communication, industrial, rectification, amateur, electro-medical, and special purpose applications.

This 578-page manual is bound in a loose leaf ring binder with a permanent plasticized cover. The manual, priced to sell at \$2.00, will be made available to qualified engineers. For a copy, write on your business letterhead to Myron Smoler of the Sales Engineering Division of the company.

#### RECTIFIERS FOR COLOR TV

The Rectifier Division of Sarkes Tarzian, Inc., 415 N. College Ave., Bloomington, Ind., has issued a fourpage brochure entitled "Selenium Rectifiers for Color Television.

The booklet includes data on seven of the company's rectifiers suitable for color TV applications along with circuit diagrams illustrating these applications. In addition, information on the company's new plug-in rectifiers is provided with dimensional details and related socket data.

#### PIPE LOCATORS

Fisher Research Laboratory, Inc., 1961 University Ave., Palo Alto, California, is now offering a 4-page brochure on its "M-Scope" line of locators.

The bulletin explains the operation of these units and illustrates the various models available from the company. Included in the line are pipe and cable finders, leak detectors, box locators, and water level indicators, Literature is available on each of these units individually.

## "WALL CATALOGUE"

A novel wall catalogue listing "bread-and-butter" condensers and containing a handy pocket for distributor order cards and "want lists" has been announced by Sprague Products Company, 51 Marshall St., North Adams, Mass.

Designed to give the technician a handy reference for the most frequently needed condensers, it also provides him with a means of noting his needs

RADIO & TELEVISION NEWS

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ADDED FEATURE:

The Model 670-A includes a special GOOD-BAD scale for checking the quality of electrolytic condensers at a test potential of 150 Volts.

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Free-moving built-in roll chart provides com-plete data for all tubes.
Newly designed Line Voltage Control compen-sates for variation of eny Line Voltage between 105 Volts and 130 Volts.

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ne Model 670-A comes housed in a rugged, crackle-finished steel cabinet complete with test leads and operating instructions.



Superior's new Model TV-11

to damage a tube by inserting it in the wrong socket.

Tests all tubes including 4, 5, 6, 7, Octal, Lockin, Peanut, Bantam, Hearing Aid, Thyratron, Miniatures, Sub-Miniatures, Novals, Sub-minats, Proximity fuse types, etc.

\*\*Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are fully tested with the Model TV-II as any of the pins may be placed in the neutral position when necessary.

when necessary.

The Model TV-II does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible

The model TV-11 operates on 105-130 Volt 50 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinel complete with port-able cover.

EXTRA SERVICE-The Model TV-II may be used as an extremely sensitive Condenser Leakage Checker. A relaxation type oscil-

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## "EICO" KITS

Electronic Instrument Co., Inc., 84 Withers St., Brooklyn 11, New York, has issued a 12-page catalogue covering the "Eico" line of kits and factorywired instruments.

The 30 kits and 33 factory-wired instruments available in the line are pictured and described in detail in this new publication. Complete specifications are given on each instrument in order to enable service technicians, students, engineers, and distributors to select the correct instrument for the job to be done.

A copy of this catalogue will be forwarded without charge upon request.

#### HICKOK BROCHURES

The Hickok Electrical Instrument Company, 10524 Dupont Ave., Cleveland 8, Ohio, now has available two brochures covering its v.t.v.m. and tube testers.

Form 209A2, a four-page booklet, lists technical specifications and uses of the company's multi-purpose Model 209A capacitance tester and v.t.v.m.

The four-page Form TT5A1 describes ten of the company's dynamic mutual conductance tube testers including those for the radio and TV technician as well as laboratory models. Graphic explanation of the dynamic mutual conductance test is also included.

## SWITCH CATALOGUE

The Disc Department of Eric Resistor Corporation, Eric, Pa., has issued a new catalogue which gives a full description, illustrations, and specifications on its new line of switches.

Twenty-five item numbers are catalogued, including single and multiple section rotary switches in shorting and non-shorting types, lever action switches, and general purpose switches.

#### SERVICE PUBLICATION

Simpson Electric Computy is sponsoring a new bulletin for television technicians, "The Technician's Timesaver."

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A complimentary subscription, at no cost or obligation, may be obtained by writing direct to Simpson, c/o Service Department, Howard W. Sams & Co., Inc., 2201 E. 46th St., Indianapolis 5, Indiana.

## TRANSISTOR BATTERIES

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excellent \$ 495 (less tubes) tubes )

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AMPLIFIER can be easily converted to 100w out board amplifiers 100w out board amplifiers 1495 complete with 3E29/8298 and conversion data....

CONVERTER can be easily converted, 995 with conversion data .....

METER 0-1kw 4" Panel Meter ..... \$ 395



#### **BROADCAST BAND** and AERO

Ideal for Use in Boats, etc. ideal for Use in Boats, etc.

MN 26 C Remote Centrolled Navigational Direction finder and commin actions receiver. Manual DF
in any one of three free, bands, 150
dynamotor supply. Complete Instance, 150
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dynamotor supply. Complete Instance, 150
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BOX	19 01	AND	PER		CAL	EF							\$69.
MN-26-Y	150 to	325	KC	. 32	5 80	69	5	K	1	3.	4	to	
7 mesa	cycles,	COUNTY	D. 0	Si T-53	Hat	lon.							49.
MN-26-C	alone.	like	The V										24.
MN-26-Y	wa to	Irma	Filler										4.
MN-20-E	Loop	Bira	nd	New									6.
MN-52 (													
M.N. 261.B	Rece	ver e	xc.	Freu	. 10	50-1	25	(): ()	K	٥.			
2.9-6mc												E	0 5

Low Freq. Crystals—FT 2d1 A for SSB, lattice filter,  $V_2$ " spc. 54th harm channels listed by fund. Fractions omitted. See previous Radie-TV News issues for frequencies

10 for \$3.00

#### POWER YOUR RIG FROM AC

RA-34 RECTIFIER. Makes a ground unit of RC-191, the 12V version of RC-375-E. Convert RC-375-E to 12V by changing beater link switches and relay connections, power it with RA-34. Input 105-125 or 210-210V, 60 e.s. Outputs. For plates, 1000V filtered de at 250 ma; for relay and mile, 12V filtered de at 250 ma; for relay and mile, 12V filtered de at 250 ma; for peaks, 12V ext. \$159.75 Used condition. F.O.B.

BC-433 RADIO COMPASS RECEIVER 200 to 1700 KC, used, excellent \$19.95 used, as is, less tubes and cover, \$6.95 

#### VHF TRANSCEIVER

the transceiver the transceiver to see the transceiver to see the transceiver to the transceiver see that the transceiver see that two individual RF sections, feeding a common 3 state tome RF amplifier. Both RF sections may be operated simultaneously, or either one individually. The operated simultaneously, or either one individually. The strength of the transceiver that the transceiver the transceiver that the transceiver that the transceiver the transceiver that th

#### A SWEET OSCILLOSCOPE DEAL

SB-7 Rader Indicate Unit: For conversion to test upon or for use as modulation monitor. Has standard st scope CR tube, H Cent. V Cent. Bril. Foe. Gain, and manie selection which. External power source was ced. Tubes: 4 65C7, 3-6Hn, 1-5HPL. Con-\$9.95 dition good, NEW ...

#### BEAM-ROTATOR

Reversible beam rotator motor 8500 rpm, attached to gear reduction box which drops speed to \$1.95 to \$1.95 for \$5.50

Hundreds of items in stock. WRITE FOR NEW BULLETIN AND PRICES. Shipments F.O.B. warehouse. 20% Deposit on orders. Minimum order \$5,00. Illinois residents, add regular sales tax remittance. Prices subject to change without

#### BC-620 TRANSMITTER-RECEIVER UNIT

FM transmitter-receiver, crystal controlled, two chan nels, freq. range 20-27.9 mc. 13 tubes, dual mete for testing filament and plate \$20.26 \$39,25 PE-117 Power supply for above, comple

#### RECEIVER

Rattery powered heterodyne receiver, 75-150 me—brand new.....ea. \$10.95

#### BC-929-A

Contains power supply 110 V. 400 cycles, has 7 tubes such as 3CPL brand new, complete with \$19.95 tubes. Each

#### **BC-746 TUNING UNIT**

Plug-in transmitter tuning unit from Army Walkle-Talkie. Contains antenna and tank cults, tuning con-denser, transmitting and receiving crystals. \$1.29 Ideal transmitter foundation......ONLY \$1.29

## CONDENSERS

#### ID6/APN4

Made to operate in conjunction with Radio Receiver R 5(1/APN-4. Unit includes 19 tubes, one 5° scope tube, crystal controlles standard oscillator, sweep circuits, marker pulses.

\$42.50

#### MIKES and HEADSETS

.52.39

CD-307 Ext. cord for 18-23-33 ... like new 1.29
Throat Mike—T-30 ... new 98
Lip Mike—Navy Type ... new 98
CW-49505 High Impedance headset complete with headband ... Used 98
HS-30, miniature headset. Used \$1.49, new 2.49

## WOBULATOR

BUILD TY-FM-AM SWEEP GENERATOR

II TUBE UHF TUNABLE RECEIVER 

#### **RA-52 RECTIFIER**

Transtat controlled to produce high voltage DC from 110 VAC 60 cycle source. Up to 11.500 VDC 6: 50 W. Motered high voltage (0-15 KV) and current (0-20 MA). Exc. \$69.95

Less Tubes BC-454 3 to 6 mc. Tubes BC-455 Receiver, 6 to 9 mc. \$2.95 BC-456 Modulator \$2.95 BC-458 Transmitter, 5 at 0 7 mc 2.95 Control Boxes, racks, mounts, connectin stock—write.	With Tubes \$11.95 9.95 4.95	New 87.95 above
MG-149F excellent condition	12	9.50 9.50 9.50
PE-206, inverter, like new	\$1	1.95
BC-640 BC-639 with BA 42 rectifier	869	5.00

#### NATIONALLY ADVERTISED TUBES

58P1 ..\$3.29 38P1 .\$3.29 5AP1 .\$3.29 3 for \$9.00 301TL Brand New in Original Cartons ... \$5.95 608 ... \$1.95 80.6 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2.95 608 \$2 QUANTITY PRICES AVAILABLE 1625, 1626, 33, 34, 954, CK1005, 627G, 9002, 9006, 1619, 955, 9004, 12A6, 1F4, 1F5, 211, 6F5, 1A6, 1629,

10 for \$3.00

RTZ APN-I TRANSCEIVER UNIT-1ltimeter, it may be converted for sig-rol circuits, etc. Used, less tubes, \$4.95 RT 14 APS 13 TRANSCEIVER Used a RU34 AP'S 13 Thankselver and a mode warning radar on 415 MC. Containing a 30MC IF Strip and various other parts, these units have been stripped of RF sections and all tubes, are an excellent buy if only for parts \$4.95 and IF Strip. Used R-1/ARR-1-20 MC converted with mil-tions becomes a high gain converter stages of RF amplification—(complete ALL THREE ABOVE ITEMS FOR \$7.50

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  100 feet of same coaxial cable
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  6 Short heaths or RGSU with connectors and sackets
  In wooden case—shipping weight
  20 fts.—all for \$14.95

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075 amp .....each \$1.95

SCR-625-FAMOUS ARMY MINE-DETECTOR For Prospectors, Miners, Oil Companies, Planders, etc. For Prospectors, Miners, Oil Companies, Planders, etc. duction in grice. Recently advertised at \$75.50 ft is now available in the same brand new wrappings in suitcase style carrying case (less batteries). \$59.50

New 8GR-522—Transceiver, complete in case \$29.95 with top bracket, jess tubes RU-19—Receiver. Complete control \$17.95 box and rolls—brand new .a. \$17.95
BC375, exc. ... \$49.50 \$49.50 49.50 14.95

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"All above probes Pat. App. for." ELECTRONIC INSTRUMENT CO.. Inc.

24 WITHERS STREET, BROOKLYN, NEW YORK

The folder describes the requirements for batteries used in transistor circuitry. Typical batteries are illustrated and described.

For a copy of this folder write Transistor Engineers in care of the company.

#### RMS CATALOGUE

Radio Merchandise Sales, Inc., 2016 Bronxdale Ave., New York 62, N. Y., has published a new catalogue which illustrates and describes the company's complete line of TV antennas and accessories.

Catalogue 55 is a 32-page, multicolored publication which is fully indexed by product groupings. It includes information on packaging and shipping weights as well as the company's gain reference chart.

#### MID-AMERICA BULLETIN

Mid-America Co., Inc., 2412 S. Michigan Avenue, Chicago 16, Illinois has recently published a 28-page bulletin which lists TV, radio, electronic and related components for manufacturers and wholesalers.

Designated as Bulletin No. 1053, the new publication is available only to recognized manufacturers and jobbers and will be sent on letterhead request from such organizations.

#### RADIO-PHONE LINE

Roland Radio Corp., 716 S. Columbus Ave., Mt. Vernon, N. Y., is now offering a 4-color, 4-page brochure covering its 1954 line of radios and radio-phonograph combinations.

Each model in the line is shown in a close-up view and specifications accompany each illustration. The back cover leaves space for a dealer imprint.

#### SPEAKERS AND CABINETS

Kingdom Products Ltd., 23 Park Place, New York 7, N. Y., has issued a four-page catalogue covering "Lorenz" speakers and "Kingdom" cabinets and combinations of the two components.

In addition to providing complete technical details on these items, the new publication carries a page of construction notes giving mechanical specifications on a series of speaker enclosures.

A copy of "Music Comes Alive" is available on request.

#### "EDU-KITS" BROCHURE

Progressive "Edu-Kits" Inc., 497 Union Ave., Brooklyn 11, N. Y., has issued a new booklet describing its 1954 radio "Edu-Kit," a home-study course in kit form.

Literature on radio and TV servicing also accompanies this brochure which is available from the company, Address all requests to Mr. R. Nevins.

#### CONVERSION CHART

The Cinema Engineering Co., Division of Aerovox Corporation, 1100 Chestnut St., Burbank, California has issued an audio power conversion chart which wifl be supplied without charge



No other converter offers all these essential functions to the degree that Granco does, regardless of price. Model LCU (only \$29.95 list) features:

#### COAXIAL TUNING...

The most efficient UHF tuning system known. Precision-ground metal slug sliding in and out of precision-ground glass tube for mechanical and electrical accuracy. No troublesome noise-producing wiper contacts. Highest stability. Provably better UHF reception.

#### FINE TUNING...

No "on-again off-again" tuning with Granco. Fine tuning is simple and positive with the high-ratio single tuning knob. Permits "on the button" tuning without need of a safecracker's touch!

#### PRESELECTION...

Tuning circuits reject unwanted signals and images—only the desired channel is tuned in. A "must" in areas having two or more channels, UHF or VHF. Granco preselection means cleaner, sharper, more pleasing pictures.

#### AMPLIFICATION...

Low-loss tuning and associated circuitry, plus true high-gain amplification of only the tuned-in channel, provides the finest reception in TV.

from your distributor or from us ASK for direct. Then compare Granco UHF converters with all other brands. Better still, make your own comparative tests. You're the judge!



Printed in card form for hanging on the wall or placing under glass tops of desks, the chart contains three columns, i.e., power level in watts, power level in db, and voltage aeross a 600ohm line

The tabulation may be used in converting from the old db system to dbm by adding 7.78 db or converting from dbm to the old system by subtracting 7.78 db. Other conversions may also be performed with the chart, complete instructions for which operations are given on the chart.

#### AUDIO GEAR

The Dubbings Company. Inc., 41-10 45th St., Long Island City, N. Y., has has issued a hi-fi catalogue covering products handled by its new high-fidelity sales department.

Pictured and described are a series of tuners for AM and FM, record players, turntables, pickup arms, tridges, amplifiers, preamps, speakers, speaker enclosures, tape recorders, disc recorders, microphones, television chassis, phonographs, "basic" audio packages, and test records.

#### RECTIFIER HANDBOOK

Federal Telephone and Radio Compuny has issued a second edition of its 'Selenium Rectifier Handbook.'

This 80-page edition contains a representative listing of the selenium rectifiers made by the company for radio and TV use. It also covers rectifier designs and power supply circuits for such applications as phonographs, audio amplifiers, amateur radios, mobile gear, photocell amplifiers, intercom systems, and other d.c. supply requirements.

Servicing and troubleshooting information is provided in easy-to-use form. The handbook, which is priced at 50 cents a copy, is available from the company's distributors or from the company direct at 100 Kingsland Road in Clifton, N. J.

#### LAFAYETTE AUDIO

Lafauette Radio, 100 Sixth Avenue, New York 13, N. Y., has just issued a 48-page catalogue comprising a comprehensive listing of high-fidelity music system components,

In addition to illustrating some custom installation ideas, the catalogue pictures and describes amplifiers, tuners, preamps, cabinets, binaural amplifiers, record changers, "packaged" installations in various price ranges, speakers, tone arms and cartridges, tape recorders, recorder accessories, and remote-control TV sets for custom installation.

#### AUTO RADIO REPLACEMENTS

P. R. Mallory & Co., Inc., P. O. Box 1558, Indianapolis, Ind., has issued an 11-page auto radio replacement control manual which covers most auto radios made since 1946.

The data is listed by manufacturer's make and model, control use, Mallory replacement controls and special bushings and switches.



# Of the very best!"

## SERIES "50"

It is only natural that more than one manufacturer will claim his product is the best. For that reason it remains for you to be the judge. We say—demand the specs. Then check workmanship, performance and beauty of appearance. If you do all these things, the answer will inevitably be . . . THE FISHER SERIES "50." There is no finer made.

## FISHER Master Audio Control

"One of the finest units yet offered to the enthusiast or audio engineer." Radio and TV News. Can be used with any amplifier. IM distortion virtually non-measurable. Complete, professional equalization settings and tone controls; genuine F-M loudness control; five inputs, five independent input level controls, two cathode follower outputs. Self-powered.

Chassis, \$89.50 • With blonde or dark cabinet, \$97.50

## Tuner MODEL 50-R MODEL 70-RT

■ Features extreme sensitivity (1.5 mv for 20 db of quieting); low distortion (less than 0.04% for 1 volt output); low hum (more than 100 db below 2 volts output.) Armstrong system, adjustable AFC with switch, adjustable AM selectivity, separate FM and AM front ends (shock-mounted), cathode follower output, fully shielded, aluminum chassis, self-powered. \$164.50 Model 70-RT, same as Model 50-R, but including tone controls, phonograph preamplifier-equalizer, and loudness balance control.

### FISHER 50-Watt Ampli MODEL

■ Truly the world's finest all-triode amplifier, yet moderately priced. 100-watt peaks! Less than 1% distortion at 50 watts (.08% at 10 watts.) IM distortion below 2% at 50 watts. Uniform response within .1 db from 20 to 20,000 cycles; 1 db, 5 to 100,000 cycles. Hum and noise more than 96 db below full output. Quality components throughout. \$159.50

Prices slightly higher west of the Rockies

WRITE TODAY FOR COMPLETE SPECIFICATIONS

FISHER RADIO CORPORATION . 39 EAST 47th STREET . N. Y. 



## THE BIG BOOK THAT Shows You How!

Judging hi-fi equipment What to avoid Loudspeakers Boss-roffex Distortion Baffles Overhand

Woofer-tweeters Sound-proofing Grillwork Output trossformers Circuits

Crossover frequencies Volume exponsion

Noise suppression Negative feedback Pre-Amps Equalizers F-M tuners Records Recording Avoiding chatter Turntables

Pick-ups Design charts Building tips . . . of

other subjects

Here, by one of the na-tion's leading experts, is the complete "know how" of high fidelity... from theory and circuits to commercial equipment; from methods and authentic technical data to home-building, custom building and service, HIGH FIDELITY TECH-NIOUES shows you what to

to home-building, building and service, HIGH FIDELITY TECH-NIQUES shows you what to do how to do it—what mistakes to avoid—which methods and equipment should prove best for your particular purpose. Written espendar purpose, written espendar purpose, whome and prove heat ular purpose. Written expe-cially for listeners, home and installation builders, experimenters and service technicians, it is a

service technicians, it is a complete, easy to understand guide to this vast new hobby that is sweeping the nation. Whether you want to specialize in the work or simply build a high-fidelity installation for your own use, the book will guide you every step of the way; help you get hetter results at less cost; and give you a full understanding of the many different methods, components and equipment that are deplated whenever hi-fi fans get together.

From beginning to end, HIGH FIDELITY TECH-NIQUES is chock full of how-to-do-it building tips, ideas and service data of the most helpful sort. Read it 10 days FREE. You be the

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City, Zone, State

# WHAT'S ALOUGH-UN-F

The products described in this column are for your convenience in keeping upto date on the new equipment being offered by manufacturers. For more complete information on any of these products, write direct to the company involved.

#### HI-FI ENCLOSURE

Now in production by Angle Genesee Corp., manufacturers of high-quality cabinets, is the Read "Fold-a-flex" loudspeaker enclosure. The original "Fold-a-flex" design first appeared in the October, 1953 issue of Radio & Television News. An improved folded horn structure has extended the low frequency response materially.

This enclosure, on which patents are



pending, may be used with a 12" or 15" coaxial loudspeaker, as a full 2way system with woofer and tweeter or a full 3-way system comprising woofer, mid-range horn, and high-frequency tweeter. An isolated compartment, for horns and tweeters, has its own mounting baffle and is available precut to accommodate standard units.

The "Fold-a-flex" incorporates three adjustable ports. These are set, by the user, to provide a choice of: 1. folded horn, 2. infinite baffle, or 3. bass reflex. The reflex port is fully adjustable to the acoustical requirements of any 12" or 15" loudspeaker.

Optimum performance (corner or wall position) is insured in any room with any of the popular high-fidelity speakers. The company is producing the "Fold-a-flex" in traditional or modern cabinetry and in a wide selection of finishes

Full information and price will be sent promptly on request to the company at 107 Norris Drive, Rochester 10, N. Y.

#### HEAVY-DUTY ROTATOR

The Trylon Tower Division of Wind Turbine Co., West Chester, Pa., is now offering a heavy-duty rotator that is capable of handling the largest beam antennas used in amateur, commercial, and military communications systems.

The rotator supports single- or two-

band arrays weighing up to 200 pounds and accommodates two coax, ribbon, or open-wire transmission lines without switching by means of separate low-leakage noise-free couplings.

The unit is driven by a special 1/25 h.p. motor that is instantly reversible for continuous rotation in either direction. The reduction gear train consists of two worm-and-spur gear sets having an over-all ratio of 2400 to 1 to prevent backlash during high winds.

Complete specifications are available from the manufacturer.

#### PRECISION RESISTORS

Hycor Company, Inc., 11423 Vanowen St., North Hollywood, California, is in full-scale production on the Type 10 wirewound resistor, a molded-inplastic unit.

The new unit is the first production type to be offered by the company in its new series "H" group of hermetically sealed resistors. It is rated at 1.4 watts at ambient temperatures up to 125 degrees C. Dimensions are diameter by 13/32" long. It is supplied in resistances from .1 ohm to 300,000 ohms at tolerances as close as 1/20th of 1 per-cent.

Descriptive material on this and other type resistors up to 1 watt is contained in Bulletin "H."

#### NEW TRANSISTOR

The Receiving Tube Division of Raytheon Manufacturing Company, 55 Chapel St., Newton 58, Mass., has announced the addition of a low-noise junction transistor to its line of p-n-p junction transistors.

The new type, CK727, has an aver-



age noise factor of 13 db. an average alpha of .97, and an average power amplification of 37 db.

Full details on this new transistor are given in a data sheet which is available from the Technical Information Service of the company.

#### COMPACT POWER SUPPLY

The Allied Engineering Division, Connecticut & Richards Ave., South Norwalk, Conn., is currently offering its Model 302 power supply.

The new unit is designed to conserve bench space as it is housed in a cab-





#### LOTS OF USES

Experimenters, laboratories, etc. will fund numerous applications for this midget storage battery. Rated 6 volts maget storage baffery. Rated 6 volts but can be easily ganged in multiples of 2 for 12 volt use and in multiples of 4 for 24 volt use. Provides 2.4 amp/hour. Popular for use in photoflash units, as a source of DC power for alarm systems, etc.

EASY TO STOCK—NO DETERIORATION
These batteries are dry—there is no acid in them \_\_\_ the vent holes are scaled. Electrolyte is put in when ready for use Istandard 1.275, available everywhere at low cost!. Battery becomes charged when put in use and and is rechargeable like any standard storage battery. Simple factory-printed instructions on each battery. 3" wire leads spot soldered to battery terminals. Shpg. wt. 2 lbs.

EVERYONE IS NEW AND PERFECT This sensational low price made pos-sible by another B-A hot buy.

No. 3A166 \$1.39 to \$4.88

Case Lots or 36..... \$39.88

#### THIS SENSATIONAL



1-115 V-6.3 V., 1 AMP FIL TRANSFORMER 1-5.P.S.T. SEMBITIVE PLATE BELAY

1-ELECTROLYTIC COMDENSER

4-CARRON INSULATED RESISTORS 7-WIRL-WOUND BESISTORS

A-PAPER TURNIAR COMDENSERS 1-CHASSIS AND HARDWARE

Here is a list of parts useful for many, many applications. Which if furnished individually would regularly cost many times the Cray Low Price we show. Originally intended as Thyratron Remote Controls for Electric Blanketa. but now available at a mere fraction of original cost because the maker had more controls than because the maker had more controls than be could make blankets. Comes completely assembled—can be modified for various remote control uses or easily taken apart for the high quality parts alone. uses or parts alo

parts alone.

Others offer these identical units as Big Bargains, and truly so, at up to double our prices. Order from B-A Now while they last at the Ridiculous Low Prices below.

Complete Assembly, including 1—45L7GT, 1—65N7GT, 1—65N5GT, and Plastic Cabinet as pictured. Shop, wt. 3½ Dis. No. 18B33

S2.88 10 Lots

\$2.88 leach \$2.50 No. 18BS3 Special Each \*No. 18B48 as ab nets.Shpg. wt. 2 Special Each 99c 10 Lots Each 89c

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Send Free B-A Catalog No. 541 My order attached for items in this ad.

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B-A'S LITTLE TUBE MAN SAYS:

"For the finest quality at the lowest prices you're always better off at B-A. It's dollar value that counts and that's what you get when you look to B-A for your every electronic need."

#### DON'T MISS THIS SPECIAL PURCHASE! **POPULAR - MAKE CONTINOUS DUTY** 1/4 - INCH PORTABLE ELECTRIC DRILL

LIST VALUE

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Built-In Spots

 Popular Jacobs
 Ceared Key Chuck Industrial Type Motor, Rated 2 Amps Under Load

· Precision Ball learings

Lightweight— Weighs Only 3 Lbs.

Not another drill on the market with so many desirable fea. tures at such a colossal low price. Modern in every aspect. A natural for every Serviceman, TV Installer, Electrician, home maker, etc. Why the Reduced Price? The manufacturer in a desire for expanding retail sales in hardware stores and the like is now providing the same drill only with a mirror finish in place of the satin finish. Not desiring to duplicate his stock with two drills of the same mechanical specifications, but of different finishes, he looked to B-A-so here it exactly as offered elsewhere except for the finish, at a terrific saving to you. Quantities limited. Order Now.

Uses quality components throughout. The industrial capacity motor is engineered for continuous trouble-free duty with smoothness contributed by the precision ball bearings.

Has sufficient power for drilling in hard woods or metals without stalling. Built-in work light focuses on work in dark recesses of cabinets, in attics when installing antennas and wiring, anywhere better visibility is required for more accurate drilling.

drilling.
Aluminum die-cast housing. 7½" heavy duty 3 cond. cord with grounding terminal for operating on 110-120 volts AC-DC. No. 37A302. SPECIAL EACH

## DELUXE REAR SEAT AUTO SPEAKER

KIT INCLUDES LARGE 6"x9" SPEAKER

Consists of top quality 6x9" Alnico V heavy magnet PM Speaker, Chrome finished Grille with flocked screen, Centralab dual Speaker Switch Kit, and all necessary mounting hardware.

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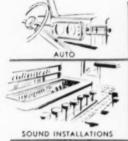
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inet measuring just 8" x 5" x 514" Two outputs are available: from 150 to 350 volts at 0-80 ma, with either positive or negative grounded to the chassis, and from 0-150 volts at 0-5 ma. with positive internally connected to the negative of output 1.

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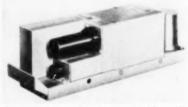
Further information on this unit and a copy of the company's d.c. power supply catalogue are available on request.

#### PLUG-IN UNITS

Langevin Manufacturing Corporation, 37 West 65th St., New York 23, N. Y. is now marketing two plug-in units which have been designed for applications where space is at a premium.

The Type 5208 plug-in power supply is designed to be used with the 5000 series of miniature plug-in amplifiers. Input is 105-130 volts, 50-60 cycles, single-phase a.c. The d.c. output is 300 volts, 90 ma. continuous. The unit measures 10¼" long x 25%" wide x 3"

A companion plug-in amplifier, the Type 5117, is also available. The new unit is a two-stage, push-pull, fixed gain amplifier rated at 8 watts. Designed to be mounted on relay racks or in consoles, the amplifier has the same



dimensions as the power supply unit. The amplifier uses two 5879 miniature tubes and two 6V6's. Gain is 55 db.

A catalogue on the company's amplifiers, power supplies, and transformers is available on request,

#### SPECIAL COMPONENTS

Transvision, Inc. of New Rochelle, N. Y., has set up a special transformer and coil manufacturing division which will design, engineer, and manufacture short transformer and coil runs.

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frequency air cores, multilayer solenoids, peaking, synchro-winding, television r.f., TV i.f., etc., while transformers including audio, power, high voltage, pulse application, synchro, etc., will be made available.

Sketches and blueprints may be sent to the division for estimates. A 4-page brochure on this new service is also available.

#### 1-KW. BALUNS

Barker & Williamson, Inc., 237 Fairfield Ave., Upper Darby, Pa., is now offering a new line of 1-kw. baluns designed to solve the many problems involved in matching feedline systems of radio transmitters to fixed or rotary antennas.

The of the new baluns have been designed for use with beam antennas employing "T" matching sections. Available in models for 20, 15, or 10 meter input, their input is designed to match a 75-ohm unbalanced feedline system, while the output, in combination with a "T" section, matches 100 ohms.

The remaining baluns in the line are for use with half-wave, folded dipole antennas. Designed for an input of 75 ohms unbalanced to an output of 300 ohms balanced, a total of five models is available for operation on 80, 40, 20, 15, or 10 meters.

Bulletin 700, giving complete details on these units, is available from the company's dealers or the company direct.

#### LOW-COST INTERCOM

Mark Simpson Mfg. Co., Inc., Long Island City 3, N. Y., is now offering an inexpensive two-station intercom which has been designated as the Masco "Small Talk"

The system comes complete with a 50-foot cable. The master unit features an "on-off" switch with volume control, an "on-off" pilot light, and a separate "press-to-talk" switch. The remote unit has a "press-to-talk"



switch which allows the remote station to originate calls to the master station as well as answer calls from a distance up to 40 feet.

The unbreakable all-metal cabinets measure 6½ " x 4% " x 4% ".

#### REPLACEMENT RECTIFIERS

Federal Telephone and Radio Company, Clifton, N. J., has introduced a new "universal" line of selenium rectifiers designed for replacement in any radio or television receiver now equipped with this component.

The new line of four models is available in packages of 12 and 24 to the carton. The rectifiers are of eyelet construction and come equipped with

mounting hardware for simplified installation. The four units are: 1236A rated at 300 ma.; 1238A rated at 350 ma.; 1241A rated at 400 ma.; and 1237A rated at 500 ma.

Additional information on these rectifiers is available from local distrib-

#### 1/4-INCH TAPE RECORDER

The Stancil-Hoffman Corporation, 921 N. Highland Ave., Hollywood 38, California, has introduced a new ½ "tape recorder-reproducer, the Model R5.

Designed for either standard rack mounting or portable carrying case op-



eration, it is available at two speeds  $(71\frac{1}{2}" \text{ or } 15")$  with a frequency response flat  $\pm$  1 db to 7500 and 15,000 cycles. The total distortion is 1% with a signal-to-noise ratio of better than 50 db.

When rack mounted the unit occupies a total rack space of 22% and has a tape reel capacity of 2500 feet.

#### BX CRYSTAL

Bliley Electric Company, Union Station Building, Erie, Pa., is now offering its "Bantam BX" crystal for use in subminiaturized communications equ.,-ment.

The new crystal is hermetically sealed and has wire leads. The range is 15 mc, to 100 mc. It has the same performance characteristics as MIL types CR-23 or CR-32.

The unit may be wired into a miniature socket or soldered to a printed circuit terminal board. Bulletin 46, containing additional technical information on the unit, is available on request.

#### WIREWOUND CONTROLS

Clarostat Mfg. Co., Inc. of Dover, N. H., is now offering an improved version of its Series 43 wirewound potentiometer.

Known as the Series 43c, the new units feature an improved wiper arm contact and end termination. The new contact allows higher resolution, more intricate tapers, and tighter tolerances in over-all resistance and linearity. Terminals are directly fastened to the winding, insuring low contact resistance. The collector and terminal are now in one piece, eliminating rivets as mechanical fasteners and current conductors.

The new series is available in resistances from 1 ohm to 10,000 ohms at

RADIO & TELEVISION NEWS

2 watts. Taps and various tapers are available. A choice of shafts, switching arrangements, and assemblies is available. At present they are being offered as initial-equipment units only.

#### TROPICALIZED CONDENSERS

Micamold Radio Corp., 1087 Flushing Ave., Brooklyn, N. Y., is now offering a line of molded tubular condensers known as "Tropicaps."

Designed for superior resistance to extreme humidity and ability to withstand severe mechanical and thermal shock and total immersion, the line is available in all standard capacitance and voltage ratings.

Bulletin 106, giving complete engineering data on these units, is available from the company.

#### PRINTED CIRCUIT TRANSFORMERS

Microtran Company, 2117 Mott Av-enue, Far Rockaway, N. Y., has developed a line of miniature transformers which have been especially designed for use with printed circuits.

These units, which range in power handling capacities from 8 milliwatts to 2 watts, are designed with special soldering tabs so that they may be inserted in a printed circuit terminal board and mounted and connected by means of dip soldering.

Resin impregnation is used to insure the strength characteristics required of units of this type. The company will supply additional details on request.

#### PERSONAL SPEAKER

Wright-Zimmerman of New Brighton, Minn. is now offering a personal speaker for radio and television applications

Designed especially for the hard of hearing, the speaker can be clipped



across the speaker terminals of any receiver and placed on the back of a chair or across the viewer's shoulder in a convenient position to the ear.

#### **NEW CONNECTOR LINE**

Two battery or portable mating re-ceptacles and plugs, equipped with center polarized pins and sockets, have been introduced by H. H. Buggie, Inc. of 726 Stanton St., Toledo 4, Ohio for application to walkie-talkie equipment and other similar electronic items.

Both types feature eight contacts. No. 2411 receptacle is pressurized to withstand 5 psi. It is 1%" in diameter and 78" thick and is designed for panel

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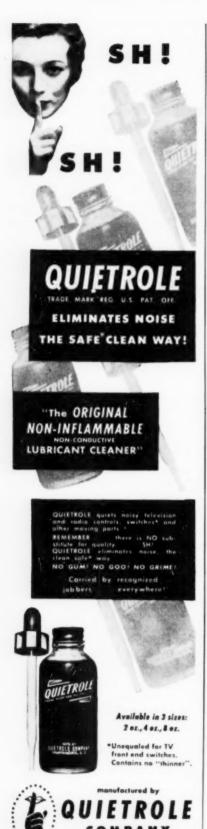
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mounting with a spanner ring. The mating plug, No. 2413, is equipped with a hood having a pull ring and right-angle cable clamp.

The HHB No. 2412 receptacle has a square flange for panel mounting. The dimensions are 11/16" center-to-center holes. Over-all thickness is %". The mating plug, No. 2611, has the same specifications as the No. 2413.

#### "GUIDE-A-TUBE

S/C Laboratories, Inc., 37 George Street, Newark, N. J., is in production on a newly-patented service aid which has been tradenamed "Guide-A-Tube.

The new unit is a low-loss plastic wafer designed to insure quick, safe, and simple insertion of miniature tubes into their sockets. The wafer is slipped over the tube pins and then the tube can be inserted into the socket with the ease of an octal, according to the company. The device is also said to reduce microphonics and prevent tube breakage.

#### TEST PROBE

Mic-Con, Inc., 521 Lehigh Ave., Union, N. Y., has introduced a new test probe which provides for instantaneous connection in any electronic circuit irrespective of space or size.

The new probe features a push-tooperate mechanism which frees the operator's hands without disturbing adjacent circuitry. This clip-on mechanism is combined with a chrome-

plate hardened steel hook which fits over circuit wiring.

A four-page brochure on this probe is available on request.

#### PARTS CABINET

Aurora Equipment Company's Equipto Division, Aurora, Illinois, has added six new storage cabinets to its line of equipment for service shops, dealer, and distributor stockrooms.

The new units combine drawers for small parts and drawers for tiny parts in a single cabinet. The small parts drawers measure 5%" wide x 11" deep



x 3%" high and are regularly furnished with two flush-fitting adjustable dividers. The tiny parts drawers' measure 11" wide x 11" deep x 114' high and can be divided into 28 separate adjustable compartments. Any two of the drawers for tiny parts are interchangeable with any two of the small parts drawers.

#### "SIGNAL SENTRY"

E. F. Johnson Company, Waseca, Minn., has developed a new product of interest to the amateur.

Known as the "Signal Sentry" the new unit is designed to perform four major station functions. It operates on all of the amateur bands to 50 mc. and

requires no tuning after initial adjustment. It monitors radiotelephone signals, monitors c.w. signals, acts as an "on-the-air" indicator, and provides for break-in by automatically muting the audio system of the receiver with



which it is used. It can also be used as a code practice oscillator.

Supplied completely wired and tested, it requires only two tubes and can be powered by the receiver power

#### REMOTE VOLUME CONTROL

Controla-Tone Company, 111 No. Tacoma Ave., Tacoma 2, Washington, is in production on an inexpensive remote control volume control which can be used with either radio or television receivers.

The new unit is a rheostatic volume control which connects to one of the speaker wires in the set. Volume can be set at any level desired by the user.

Simple installation instructions are packed with each unit and installation can be completed in a matter of minutes.

#### TUBE CADDY

Windsor Electronic Tube Co., 1515 Sheepshead Bay Road, Brooklyn 35, N. Y., is now offering a sturdily-built tube caddy which is capable of holding all the necessary tubes, meters, and tools for servicing in the home.

This compact and light caddy is fully described in an illustrated bulletin which the company will send free on request.

#### TAPE SPLICER

Cousino, Inc., 2321 Madison Ave., Toledo 2. Ohio has just introduced a new splicing device for magnetic recording tape.

The back of the splicer, formed in plastic, is provided with an adhesive mounting material for firmly attaching it to the tape recorder or work

The splice is quickly and neatly accomplished by pressing the tape ends into a groove, overlapping each other about one-half inch. No clamps are necessary, edge friction holding the tape in place. The ends are then trimmed by running a blade through a guide slot and pressing the splicing tape over the joint. The company will send a free folder on request.



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#### Applause Meter

(Continued from page 83)

of voltage gain or db level. In such a case, new resistors may be chosen for this network. Refer to Federal's "Reference Data for Radio Engineers" for the necessary design formulas.

A continuously variable attenuator control may be provided if desired. Simply use a standard 1000 ohm potentiometer in place of S, and its associated resistors

If the completed instrument is to be used in other than "applause meter" applications, the builder may wish to provide frequency selective filter networks so the frequency response of the amplifier can be adjusted for special measurements. Again, filter network design data will be found in the handbook mentioned previously.

Calibration: As long as the instrument is used only as a peak-reading device, there is no need for meter scale calibration, either in db or in other terms, and none is provided in the model. Should the builder wish to use the instrument for absolute sound level measurements, however, not only will scale calibration be necessary, but the attenuator switch will have to provide precisely known amounts of attenuation.

Meter calibration is best carried out by borrowing a standard sound-survey meter or similar instrument and obtaining comparative readings. The final calibration may either be a chart or curve or, if preferred, a new scale may be prepared for the meter itself.

#### **Applications**

To use the completed instrument as an applause meter, place it on a small stand or table with the microphone facing the audience. Set the attenuator switch (S1) in the maximum attenuation (minimum signal) position. The meter switch (Sa) may be set either in the "filter" or "peaks" position, as preferred by the individual operator, but the switch position should be left fixed during any series of tests.

The power switch should now be turned "on." The meter reading should be noted during the program and the attenuator switch adjusted for a onethird to one-half full-scale reading during a particularly good "hand" and before actual "voting" takes place. As an alternative, the audience may be asked for a good "hand" before the program starts, and the attenuator switch adjusted at this time.

Once set, the switch is left in position until all contestant "voting" is completed.

In some cases it may be desirable to have two or three "judges" to note the mater reading during voting to avoid any possibilities of error.

In addition to its use as an applause meter, the completed instrument has many other possible applications. For example, when placed in front of a

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receiver's loudspeaker, it may be used as a "no connection" output meter. Good results can be obtained in this application if the background noise level is not too high.

When calibrated, the instrument may be used as a sound-survey meter and, in this application, is useful for checking noise levels in offices, stores, schools, and factories. In many cases, the background noise level has a definite effect on workers' efficiency.

When used in conjunction with a fixed audio signal source, the instrument will permit tests of the comparative sound absorption qualities of different types of draperies, acoustic tile,

and floor coverings.

Installers of p.a. systems could use such an instrument for cnecking sound distribution in 'a particular installation, both to insure adequate coverage

and to prevent "loud spots."

These suggestions cover only the more obvious applications, however. The reader will undoubtedly think of many additional applications both in regard to his own work and of a general nature. -30-

#### Power Amplifier Output

(Continued from page 54)

of 30 watts direct on the "MED" output scale. This means with minimum efficiency we can expect an output of 30 watts from this tube. By pivoting the indicator on 20 and passing through the efficiency range for class C amplifiers we read increasing outputs finally reaching 80 watts at

80 per-cent.

On the other hand, assume that 5 watts of r.f. driving power is required and a buffer of adequate plate dissipation must be selected. Place the indicator on 5 on the "LO" power output scale and on 70 per-cent on the scale. We read a dissipation of slightly more than 2 watts on the "LO" dissipation scale. Pivoting on 5 down toward 60 per-cent we see an increase in dissipation allowance to over 3 watts. Thus, while a 2 watter operating at good efficiency will do, a 3 or 312 watter would be a safer choice.

It should be remembered when estimating power output that coupling networks may also dissipate power. Generally, these circuits can be made highly efficient by good design and construction, and these losses can be neglected in the estimate. Also remember that push-pull amplifiers have an allowable dissipation of twice the

single tube value.

Table 1 is a tabulation of multiplying factors for various amplifier plate efficiencies. A rule-of-thumb for quick mental estimates can be deduced from this table. Notice that if the numerator and the denominator of the efficiency fraction are consecutive integers such as 4/5 or 6/7 the output multiplier is the numerator of this fraction. This rule applies for efficiencies of 1/2 or more. For

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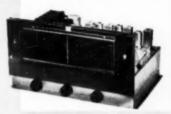
IF-6 Amplifler

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**AM-4 Tuning Unit** 

Tops in AM superhet performance! A 3-gang tuning condenser gives 3 tuned stages with high sensitivity and selectivity. Assembly is completely wired, tested and aligned ready for immediate use. Frequency coverage 540 KC to 1650 KC at a tensitivity of 5 microvolts. Tubes 68A6 FF amplifier ond 6AT6 detector. Draws 30 ma @ 220 volts. Mounts on a chassis plate measuring 4"x73@. Shipping weight 2½ lbs. Dial available at \$3.85.



FM Tuner Kit

The FM-11 tuner is available in kit form with the IF Amplifier mounted in the chassis, wired and tested by us. You mount the completed RF Tuning Unit and power supply, than after some simple wiring, it's all set to operate. 11 tubes: 636 RF amp. 6AG5 converter, 6C4 escillator, 48A6 1st IF. (2) 6AU6 2nd and 3rd IF, (2) 6AU6 limiters, 6AL5 discriminator, 6AL7-GT double tuning eye, 5Y3-GT rectifier. Sensitivity 6 to 16 microvolts, less than 1/2 of 1% distortion, 20 to 20,000 cycle response with 2DB variation. Chassis dimensions: 121/2" wide, 8" deep, 7" high. Illustrated manual supplied. Shipping weight 14 lbs.



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eye assembly and complete structions. All tubes included. Shipping weight 19 lbs.

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efficiencies of ¼ and ¼ notice that the multiplying fraction is the same with the denominator diminished by one. For example, if a tube of 250 watts maximum allowable plate dissipation is operated at % efficiency (75 per-cent) the output is 3 x 250 or 750 watts. At 1/3 efficiency (33.3 percent) the output is 1/2 x 250 or 125 watts.

The analytical basis for the nomograph in this article is as follows:

If  $P_n$  is power output,  $P_n$  is power input, and E is efficiency,

 $E = P_{\circ}/P_{\circ} \quad . \quad (1)$ 

 $P_i = P_i + P_o \dots \dots \dots \dots (2)$ if  $P_a$  is the power dissipated in the amplifier. Substituting eq. (2) in (1)

 $E = P_a/(P_d + P_a)$ rearranging,  $P_o = EP_d/(1-E)$  . (3) -30-

#### Crystal Substitute

(Continued from page 47)

transmitter was wired to key both stages as described in the step-by-step assembly instructions, the oscillator signal on 80 meters does not interfere with listening on that particular frequency. On forty meters the signal is hardly noticeable.

The transmitter is tuned the same way that it would be tuned when using a crystal. However, care should be exercised in setting the oscillator within the amateur bands. This can be done quite easily with a calibrated receiver or by listening for other amateurs on either side of the frequency which you wish to use. If more bandspread is wanted, remove two of the rotor plates from the 50 µµfd. tuning condenser, or substitute a smaller condenser. Of course, on forty meters the dial division coverage will be less than half of the 80-meter band, so make the adjustments carefully.

In the photograph of Fig. 1 showing the v.f.o. and transmitter, the oscillator coil seems to be too close to the transmitter cabinet. This does not affect the operation of the v.f.o., nor does it affect its stability. The oscillator coil should be mounted as far away from the tubes as possible to prevent heat drift.

The photograph of the inside of the v.f.o. box (Fig. 3) shows the arrangement of components. Placement of parts is not too critical and almost any arrangement can be used. The 100 µµfd. padding condenser is mounted so that screwdriver adjustments can be made from the top of the box. Inserting and removing the screwdriver when making adjustments should not cause too much change in the setting of the oscillator frequency.

No trouble should occur by following the general v.f.o. layout shown in the photographs. Careful placement of parts and normal construction procedure will provide a compact, stable -30-

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## Technical BOOKS

"GUIDE TO AUDIO REPRODUC-TION" by David Fidelman. Published by John F. Rider Publisher, Inc., New York. 228 pages. Price \$3.50. Paper bound.

This is a companion volume to Harold D. Weiler's "High Fidelity Simplified" (*Rider*) which was written for the audiophile without technical background. This book is addressed to the experimenter, engineer, and technician. The approach is more technical than the previous volume and delves into the "why's and wherefore's" more deeply.

The text material covers the highfidelity reproduction of sound, sound principles, sound reproducing systems, input and pickup units, audio amplifier theory, practical audio amplifier circuits, a.f. networks and corrective circuits, loudspeakers and loudspeaker enclosures, complete hi-fi systems, magnetic recording, and the measurement of quality of audio reproduction.

Readers of this magazine are long familiar with the author's style as he has contributed numerous articles on audio subjects. They will find that, like his articles, this book is written in easy-to-understand style. The text material is lavishly illustrated and amplified by means of photographs, circuit diagrams, and graphs.

Those who install, service, or build audio equipment will find this volume a welcome addition to their bookshelves.

"MOST-OFTEN-NEEDED 1953 RADIO DIAGRAMS" compiled by M. N. Beitman. Published by Supreme Publications, Chicago. 192 pages. Price \$2.50.

This is the thirteenth volume in the "radio" series published by Supreme. As is the case with the previous volumes, this new publication reproduces

umes, this new publication reproduces factory service data as supplied by the manufacturers represented. Included are AM and FM radio receivers, auto radios, portables, combination sets, record changers, and receivers employing printed circuits.

The products of approximately thirty-five companies are covered in this particular volume.

"RADIO DATA CHARTS" by R. T. Beatty, revised by J. M. Sowerby. Published by Hiffe & Sons, Ltd., London. Available in the U. S. from The British Book Centre, 122 E. 55th Street, New York 22. 91 pages. Price \$1.75.

This book is a series of 43 nomographs covering data required in the design of radio receivers.

These nomographs originally appeared in the British technical journal, "Wireless World", and have been assembled in this convenient form for reference purposes.

The charts cover such items as frequency and wavelength; inductance,

capacity, and frequency; self-inductance; r.f. coil windings; reactance of coils or condensers; transformer design; choke and transformer design; etc.

The only "equipment" required to utilize any of the nomograms is a straightedge. All the desired data can then be read directly.

For the engineer, the experimenter, or the hobbyist who likes to "roll his own" either as a vocation or an avocation, this book should be invaluable.

"DATA AND CIRCUITS OF TELEVI-SION RECEIVING VALVES" by J. Jager. Published by *Philips Technical Library*, Eindhoven. Available in the U. S. from *Elsevier Press Inc.*, 402 Lovett Blvd., Houston 6, Texas. 215 pages. Price \$4.50.

This is the third in the current Philips series dealing with electronic tubes and covers the tubes encountered in modern television receivers.

The discussion centers around tubes made by *Philips* in Holland for receiving sets operating on European standards. In this respect the text is not directly applicable to U. S.-made receivers but the basic engineering data contained in the book as well as the receiver circuity will be of interest to all in the television field.

The book is divided into three sections. The first discusses each type of tube and provides full information on applications and correct operating conditions. The second section covers typical circuits while the third contains a short description of various measuring instruments suitable for testing, troubleshooting, etc.

"TECHNIQUES OF TELEVISION PRODUCTION" by Rudy Bretz. Published by McGraw-Hill Book Company, New York. 464 pages. Price \$10.00.

This is a comprehensive handbook for the studio engineer and technician as it covers all of the equipment and materials used in producing television programs.

The book is divided into twenty chapters which deal with the television cameraman, cameras, and camera handling; TV lenses; cutting; switching equipment; technical limitations and the production problems involved; graphic materials; projection equipment; mirrors and prisms; composite shots and the illusion of space; special effects with graphic materials; studio effects; electronic effects; television scenery, make-up, and lighting; audio problems in TV; and remote pickups.

The author has prepared this material based on the assumption that personnel at the average television station (non-network originating station) has to "double in brass." Many "engineers" in smaller stations are vitally involved in "production" and vice versa and the author rightly feels that a broadening of the scope of both the "engineer's" and "production man's" job is a natural process to insure close coordination in all facets of programming.

We predict that this book will be-

come a "standard" in the production field as the material covered is primarily basic and, on the whole, not subject to obsolescence even in the face of the imminence of widespread color telecasting

"RADIO AMATEUR QUESTION & ANSWER LICENSE GUIDE" compiled and published by American Electronics Company, 1203 Bryant Ave., New York. 32-pages, 50 cents, Paper bound.

This compact handbook carries sample questions and answers for Novice, General, and Technician classes of li-

cense examinations.

The material is divided into sections, one covering the Novice class and the balance the General and Technician classes. Practice questions cover the basic electricity, power supplies, transmitters and receivers, and rules and regulations elements for the Novice class and the same elements for the other two classes with the addition of the element covering vacuum tubes and audio amplifiers.

"UHF TELEVISION ANTENNAS AND CONVERTERS" by Allan Lytel. Published by John F. Rider Publisher, Inc., New York. 113 pages. Price \$1.80. Paper bound

This is a practical handbook for the television service technician. It explains in easy-to-understand terms just how the various u.h.f. conversion systems work and how to select and install suitable antennas to be used with sets operating in the ultra-high television bands

The book is divided into seven chapters dealing with conversion systems and installation problems, transmission lines, antennas, converter circuits, single-channel converters, full-range converters, and all-channel tuners.

The author describes and discusses some commercial units as typical of the units available. The lavish use of circuit diagrams and photographs enhances the value of this work as a guide to servicing procedures.

Any technician familiar with v.h.f. receiver circuitry will be able to handle the material in this book. Treatment is non-mathematical and explanations are lucid.

#### READERS' BOOK SERVICE

AT THE suggestion of many of our readers, who either live in communities which do not have adequate bookstore facilities or who would like to enjoy the convenience of receiving their books by mail, we have established a Book Department in this magazine.

This department will be able to supply its readers with any book in print in our field. Each month it will carry advertisements featuring a number of important radio-TV-audio-electronics titles, new and old, issued by leading publishers of this country.

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BC-450	3-RECEIVER REMOTE		MC-211 90° ANGLE COUPLING UNIT		\$0.98
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MC-215	MECHANICAL DRIVE SHAFT.		transmitter	2.95	3.90
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#### International Short-Wave

(Continued from page 84)

Colombia - Bogota, 6.000, noted 2200-2300 with Spanish news, music, (Zerosh, Pa.) HJKH, 5.070, Sutatenza, announces 5.070 and 1580 kc., closes with National Anthem 2100; announced Sun. opening as 0800; on Sat. has "La Accion Cultural Popular esta en Marcha" before closedown: good level: all-Spanish. (Kahan, Calif.) NNRC reports Radio Continental, HJKE, 4.835, Bogota, logged 2105-2200 in Spanish.

Costa Rica-TIFC, 9.645, noted 2300-2330 Sun. with "Old-Fashioned Revival Hour." (Tandrow, Calif.) Heard closing 0005; requested reports to "Light-house of the Caribbean," Box 1307, San Jose, Costa Rica. (Smith, Ga.)

Cuba-Radio Reporter, COCW, Prado 53, Havana, lists 6.330 (measured 6.314), at 0600-2400, 1 kw. (Roberts, Conn.) COKG, 8.955, Santiago, noted at high level 1530. (Grenell, Ohio)

Czechoslovakia-Prague, 9.504, noted signing on English session 0715; ran to 0740. (Pearce, England) Heard on 7.255 at 1930-2000 with news for North America. (Smits, Minn., others)

Denmark-Copenhagen, 15.165, strong 0700-1000; English 0950; is beamed to South Asia. (Saylor, Va.; Kirby, Mo.; Earnhardt, N. C., others)

Ecuador-HCJB, 9.745, noted ending Russian 0100, continuing in Spanish. (Wilcox, Mo.; Milnes, Ore., others) Heard on 17.890 to Europe with Swedish 1535. (Saremba, Va.)

Egypt-Radio Cairo, 15.315, noted 0915 with Arabic music; closed 0930 after call in Arabic. (Pearce, England) Noted on 11.965 with Arabic music 1445. (Ferguson, N. C., others) The 9.475 outlet is strong around 1500. (Mitchell, N. Y.; Zerosh, Pa., others)

El Salvador - YSUA, 6.100A, San Salvador, noted in Spanish 2130-2230. (Kahan, Calif.) San Salvador, 9.55A, noted closing in Spanish 2330. (Zerosh, Pa.) YSS, 6.010, heard with marimba music and announcements in Spanish at 2310 to closedown 0006 (Roberts. Conn.) YSWW, Santa Ana, noted best 2030-2100. (Stark, Texas) YSAXA, 11.950, noted 1540-1600, good level, (URDXC)

Ethiopia - Radio Addis Ababa, 15.047AV, noted with news some days 1315-1325, then dance music with English vocals. (Zerosh, Pa.) Seems to have recorded music 1330-1400 with announcements in English. (Earnhardt, N. C.)

Finland-Revised schedules of Helsinki include to South America 0430-0550 on 15.190, 17.800; to North America 0600-0800 on 15.190, 17.800; from 0700 also on 9.555. (WRH)

France-Paris, 9.550, noted 0400 with music. (Tandrow, Calif.) Noted-closing 1600 on 7.105. (Zerosh, Pa.; Ferguson, N. C.) Heard on 5.955 in Spanish to 1645 closedown. (Stark, Texas) Noted closing 0715 on 21.740. (Gillett, Australia) Excellent on 15.400 closing 1000. (Bishop, Ohio)

French Equatorial Africa - Radio Brazzaville, 11.970, 9.440, has French-English lesson ("The French Have a Word For It") at 1445-1500; news to Far East on these channels 1100. (Pearce, England)

French Guiana - Radio Cayenne, 6.205, noted with news in French 1800 (by woman); poor level and with QRM from Rome, 6.210. (Huttemeyer, N. J.; Mercier, France)

French West Africa-Radio Dakar, 9.560, noted with call and news in French 1500; at 0200 with recordings. (Pearce, England) Heard 0100-0300, 0700-0900, 1300-1900. Heard opening 0130 with "La Marseillaise" on 4.950; good level to 0300 tune-out. (Nilsson, Sweden: Morris, Pa.) Noted on 11.896A in French 1355-1550 and later. (Roberts. Conn.)

Germany -- Cologne, 11.795, noted 1210-1224 fade-out. (Miller, Ga.)

Greece-The Greek station near 7.088 has been identified as Jannina: strong with recordings when tuned 1300. (Pearce, England) Forces Sta-7.420, Athens, is very good strength to 1704 closedown. (Buggins, England)

Greenland-OZL, 7.570, noted 0900-0945 with Danish or Icelandic and playing popular music. (Cody, Ireland)

Guatemala-TGNA, 5.952, noted 1750 with musical program. (Ferguson, N. C.) Heard closing English 2345. (Mitchell, N. Y.) TGNB, 9.668A, noted recently parallel TGNA, 5.952 with Spanish-English lesson 1900. (Bellington, N. Y.)

Haiti-Radio Haiti, 4VHW, 5.840, and 4VRW, 10.070A, is scheduled 0700-2200 weekdays, 0930-1800 Sun.; QRA is Radio Haiti, P.O. Box 737, Port-au-Prince. (ISWC, London) Radio Commerce, 4VC, 9.485, noted from before 0700 (probably still opens 0630) and still on the air at 1710. (Ferguson, N. C.) Heard closing 2300 on 6.095A in French and English, followed by National Anthem. (Zerosh, Pa.) 4VEH. 9.667A, good level beginning English 0805. (Bishop, Ohio) Radio Citadelle, 4VWA, 6.300, Cap Haitien, noted 2058-2205 closedown in French. (Roberts, Conn )

Hawaii-VOA relay, 6.195, excellent 0515. (Reidler, Pa.)

Holland-Radio Nederland, 9.59, good level with English 1100. (Lund, Iowa) Noted on new 9.745 channel 1145 with Arabic, parallel 9.59. (Bellington, N. Y.)

Hondura's-HRTL, Radio Tela, 6.035, is on the air daily except Sun. 0900-2300; has American music and songs 2120-2200. (ISWC, London) HRXW, 6.110A, Comayaguela, noted fair level closing 2300. (Niblack, Ind.)

Hong-Kong-ZBW3, 9.525, Victoria, noted with BBC news relay 0600. (Morgan, Calif.)

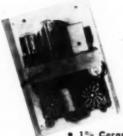
Hungary-Radio Budapest, 9.833, noted 2215-2230 in English with world news. (Rugel, Kansas)

India-Madras, 4.920, noted with news relay from Delhi 1030. Also at that time from Delhi, 9.750A, 4.760A. (Pearce, England) Heard closing on

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7.155 in English to Great Britain, Ireland 1644. (Ferguson, N. C.) Heard to South, East Africa 2300-0010 on 15.130, 11.870; to Far East on Sat., Sun. in English 0715-0730 over 9.670, 7.155, very strong signals in Tokyo. (Wada, Japan) Heard in French 1500 over 4.940. (Buggins, England) Noted in Calif. on 6.075 from around 0930 to after 1000 with English announcements. (Morgan, Balbi, Calif.)

Indo-China (Vietnam)-"The Voice of Vietnam," 9.620, has English 0930; Radio Dalat, 7.265, has French 0630-0730, closes 0745 with interval signal by native instrument; Radio Hue, 7.205, is heard 0815-0900 in French and with music, then closes with National Anthem. (Japanese Short Wave Club) Radio France-Asie, Saigon, is heard on 9.750A to Europe in French 1035-1100, then English to 1130A when closes with "La Marseillaise." (Pearce, England; Mesquita e Sousa, Portugal, others)

Iran-Radio Sanandaj broadcasts on 6.755 from 0830; heard in Germany. (ISWC, London)

Israel-Tel Aviv, 9.009A, opens 1415. (Niblack, Ind.) Sent verification form letter and listed "Voice of Zion" relay



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Jamaica-Radio Jamaica, 3.36, is good level to 2300 closedown; at times

has QRM. (Jannis, S. C.)

Japan-The 7.180 outlet of Radio Japan is heard 0030 with news. (Tandrow, Calif.) Also good on 9.695 in parallel. (Stein, Calif.) When this was compiled, Radio Japan was being heard on 11.725 in Eastern USA in beam to South America 1700-1800 in Spanish, Portuguese, Japanese. (Ferguson, N. C.; Niblack, Ind., others) JBD3, 15.225, is fair 2200 to 2300 signoff, in Japanese. (Morgan, Calif.)

Kenya Colony-VQ7LO, 4.855, Nairobi, is heard 1000-1500; 1300 BBC news relay; 1315 local news, then music; leaves air 1400 Sun. (ISWC, London)

Lebanon-Radio Beirut, 8.036, noted from 1415 tune-in to 1500 with Arabic, then music: news in Arabic 1520-1530 sign-off (Sun.) with National Anthem. (Saylor, Va.)

Libya-The Forces Broadcasting Service, Benghazi, has been using 0.5 kw. on 4.782 and 4.965; further tests with 7.5 kw. were to begin soon; scheduled 0000-1600; QRA for reports is FBS, Middle East No. 5, Benghazi, Cyrenaica-Libya. (ISWC, London) In verifying, asked for further reports; not audible lately. (Pearce, England)

Malaya-BFEBS, 11.820, noted to around 0900. (Stark, Texas) With

news 0430. (Balbi, Calif.)

Mexico—XEVC, 9.630A, Mexico City,
announces "XEV y XEVC, La Voz y Expression de Mejico," has news in Spanish weekdays 2315. (Kahan, Calif.)

Mozambique-CR7BU, 4.920, Lourenco Marques, is heard in the United Kingdom to 1600 (Sat. to 1700) through heavy CWQRM; CR7BV, 4.872A, has programs in Portuguese 1300-1615. (ISWC, London) News in Portuguese noted on this one 1500. (Mesquita e Sousa, Portugal) The 11.742AV channel is being heard again from 2300 in English. (Niblack, Ind.)

Nicaragua-YNBH, 6.547, Radio Panamericana, noted going past 2405 late-

ly. (Stark, Texas)

Norway-Radio Norway, 11.735, noted Sun, with English ("Norway This Week") 1200-1215A. (Roemer, Ky.) Heard on 11.850A at 1050-1100 with church music (Karrer, Pa.) Good level on 7.210 at 2000-2100. (Zerosh, Pa.)

Okinawa-The VOA relay is now scheduled over 6.145 at 0500-0945 to China-Korea. Noted by Ballou, Calif., strong at 0555 on measured 6.1463.

Pakistan-Radio Pakistan, 17.710. noted with news 0330. (Cushen, N. Z.) Heard over 7.010, 6.235 with slow-speed news 1310-1330, opening on these channels 1445 to Turkey. (Pearce, England) Heard on 5.990A with news 1015. (Morgan, Calif.)

Panama-HOLA, 9.505, Colon, noted in English 1630. (Jannis, S. C.) Radio Baru, David, is still on 6.045 and goes

past 2045. (Stark, Texas)

Peru - Radio Nacional del Peru, OAX4R, 15.150A, Lima, has special broadcast to Europe and North America 1200-1400 and requests reports; announces in English, French, Spanish. (ISWC, London) Heard closing on OAX4T, 9.562, at 2400 in Spanish, English, French, followed by National Anthem. (Smith, Ga., others)

Philippines - DZH7, 9.73, Manila, heard as early as 0100, signing off 0145 and returning around 0245; DZH9, 11.855, audible with fair level then. (Balbi, Calif.) DZH5, 9.69, noted at nice level with news 0615. (Saylor,

Va.)

Poland-Radio Warsaw noted near 5.93 and 6.192 (varies as high as 6.197) with news 1730-1800; with English 1400, 1500 on 6.025. (Pearce, England)

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Heard opening 1501 on 6.195 with English for Europe, fair level. (Bellington, N. Y.)

Portugal-Lisbon, 6.374, noted 1700-1830 with Portuguese news. music. (Zerosh, Pa.) Overseas Service is now scheduled 0600-0800, 0945-1200, 15.030; 1230-1530, 11.836, 11.996; 1600-1830, 11.960, 11.996; 1900-2100, 5.976, 6.374, 9.746. (WRH) Heard recently on 9.795A around 1340 parallel 9.740. (Earnhardt, N. C.; Bellington, N. Y.)

Portuguese India-Radio Goa, 9.610, now seems to have "The Catholic Hour" in English daily 1100-1130; closes down 1230. (Pearce, England)

Portuguese Guinea-CQM, Bissau, has been reported heard in Sweden and Belgium testing on 9.380 from 1640 to 1800 closedown. (Radio Sweden)

Reunion St. Denis is using 4.820, 7.170 in French 2130-2245, 0300-0430, 0900-1330 weekdays, and 2300-0000, 0130-0530, 0900-1330 Sun. (Scheiner, N.J.

Roumania-Radio Bucharest, 9.254A, noted 1447 with news by man and woman. (Ferguson, N. C.) Heard opening on 9.57 at 1200 preceded by interval signal and a long march sung by chorus; then appeared to use Roumanian. Heard with English 2200-2230 to North America; good level but with bad QRM at times. (Saylor, Va.; Bellington, N. Y.)

Sao Tome-Radio Clube de Sao Tome e Principe, CR5SB, 17.677A, noted Sun. 0700-0800, very weak level in Portuguese. (Mesquita e Sousa, Portugal) CR5SC, 4.807, heard 1530-1600 closedown. (Miemois, Finland)

South Africa SABC noted "calling Africa" closing 1535 on 11.937; news 1500. (Pearce, England)

Spain-FET1, 7.006, Valladolid, noted 1815 with variety program of music; faded out before 1830; all-Spanish; "Transmite Emisora La Radio Puerto Santa Maria," 7.210A, noted 1740 with varied recordings. (Pearce, England) Madrid, 9.363, noted with English to North America 2215-2245A. (Irvine, Texas, others) And 1800-1840A. (Parrish, Ga.; Connelly, O., others) A new station is Radio Falange de Villanueva, 7.015, at 1500-1615; relays news in Spanish from Madrid at 1600. (WRH) Sweden-Radio Sweden, 7.210, noted

1300 with English for Africa. (Pearce, England) Heard with news 1930 over 6.065. (Roemer, Ky., others)

Switzerland-Home Service noted over HER22, 3.985, at 1645 with music. Noted opening in English to Great Britain, Ireland 1345 on 6.055, 9.665. (Pearce, England) This beam is heard well 1345-1530 closedown over the 9.665 outlet. (Smits, Minn., others) The 11.865 outlet noted opening 1015 at good level. (Welch, Mass.) The 9.535 channel is noted 1325 with news in German. (Saremba, Va.)

Taircan-"Voice of Free China," Taipeh, noted on 11.735 in English 0045 asking for reception reports. (Gillett, Australia) Taipeh, 9.785, heard with Western music 0500-0600, good level. (Balbi, Calif.)

Tangier-Radio Africa, 7.193, noted

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with Spanish songs 1700; intermittent QRM. (Pearce, England) Pan American Radio uses 1178 kc., 7.290 at 0400-2000 in six languages. (WRH)

Thailand-Radio Thailand, 11.670, noted 0855 with Home Service relay; closes 0920. (Pearce, England) With news 0500-0520, in Overseas Service, then with program for Thai Forces in Korea. (Churchill, Calif., others) The North American transmission on 11.670 at 2315-0015 is audible in Australia. (Radio Australia) This transmission is seldom if ever heard in North America.

Trieste-British Forces Station. 15.125, is heard in Sweden around 1500, Trinidad-Radio Trinidad, 6.085. Port-of-Spain, noted with popular recordings, time checks 0505-0525. (Morris. Pa.) Lists this outlet at 0500-1700:

3.275 at 0500-2200. (Hardwick, N. Z.) Vatican-HVJ, 11.685, is coming in fair to good with English 1000-1015; and on Tue. only with further English 1030-1045 (to India, Pakistan, Ceylon). (Miller, Ga., Saylor, Va., others) Noted closing 0545 on 21.740, very good level; schedule on this channel seems irregu-(Gillett, Australia) Noted on 9.646A with English 1315-1330, good

level but with QRM. (Niblack, Ind.) Venezuela-YVLK, 4.970, Caracas, Radio Rumbos, noted closing 2230 with National Anthem; on Mon., Thurs., at 2230 has "Luz de Luna y Sombras." (Kahan, Calif.) YVMF, 4.800, Maracaibo, noted 2230 closing with English and Spanish announcements. "Goodnight, God bless you, and very happy dreams;" asks for reception re-ports. (Niblack, Ind.) YVMQ, Radio Barquisimeto, 4.940, noted 1935 with heavy QRM. (Hill, Mass.)

Yugoslavia-Radio Yugoslavia is using 6.100, 7.200 at 1645 with news. Recently tested on 6.100 at 0400-0800. (Pearce, England) Heard 2230 with strong signal in Texas. (Frazier)

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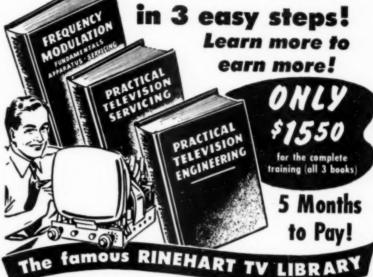
At press time, tentative arrangements had been made for your shortwave editor, Ken Boord, to present a program of Passion Week and Easter organ melodies, by tape transcription, in a special DX broadcast dedicated to short-wave listeners throughout the world. The program will be aired over TGNA ("Telling the Good News Abroad"), the radio voice of the Central American Mission, Apartado 601, Guatemala City, Guatemala, Central America, at 2315-2345 EST on Saturday, April 17 (Easter Sunday, April 18. 0415-0445 GMT), over TGNB, 9.668, and TGNC, 11.850.

Harold Van Broekhoven, director of TGNA, airmails that all correct reception reports will be verified by a QSL card and a mimeographed letter which tells of the work of TGNA-sent by airmail. "We appreciate it when the listener encloses an IRC." he says, "but we will not make this a requirement."

#### Press Time Flashes

A station in Arabic noted on 11.720





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around 0930 with Eastern-type music is believed to be ZJM7, Limassol, Cyprus. (Ferguson, N. C.) Radio Cultura, 6.165A, Sao Paulo, Brazil, noted with English around 2310 and 2325; asked for reports. (Niblack, Ind.) Indonesian Air Force Station, Djakarta, 11.945A. heard opening 0425 with plane sounds, followed by American musical program; signs off 1030.

The Japanese Short Wave Club, Box 29, Sendai, Japan, is eager to increase its membership throughout the world; its monthly bulletin is all-English; details can be had by writing direct to the club. Miller, Ga., reports AFRS relay station in Puerto Rico heard on 7.800A with news 1800. At press time, Pearce, England, noted that Radio Beirut, 8.036, Lebanon, appeared to have dropped its English session 1000-1100; was using Arabic then.

Radio France-Asie, Saigon, Indo-China (Vietnam), noted moved from 6.225 to 6.17. (Balbi, Calif., Gillett, Australia, others) Latest schedules list English for India, Asia on 7.230, 1830-1900; 11.935, 2030-2045; 11.935, 0900-1115; and with new "French by Radio" session to Australia on 15.430 on Tue., Thur., Fri. 0345-0400, to India, Southeast Asia on 11.935 on Sun., Wed., Fri., 1045-1100. (Catch, England) Radio Tirana, 7.850, Albania,

now has English 1400, 1700 (WRH) At press time, "Deutsche Welle," Cologne, Germany, was scheduled 0530-0830 to Far East, 11.795, 15.275; 0930-1230 to Near East, 7.290, 11.795; 1300-1600 to Africa, 7.290, 11.795; 1700-2000 to South America, 2030-2330 to North America, 5.980, 7.290. (WRH) Press dispatches from South Korea indicate that Radio Pusan was destroyed by fire. Operated on 7.935A. Back on the air? (NNRC) English news is scheduled from AIR, India, 1930-1940, 9.755, 7.170; 2310-2320, 15.130, 11.870; 0235-0245, 17.740, 15.380; 0835-0845, 11.790, 9.565; 1045-1055, 15.210, 11.790.

Saudi-Arabia plans to have its new 100 kw. transmitter completely installed by the end of 1954; then will use Turkish, English, other languages in addition to Arabic. (Scheiner, N. J.) TGNA, 5.952, TGNB, 9.668, are used for English 2200-2345; asks for reception reports to Box 601, Guatemala City. (Cook, Calif.)

#### Acknowledgment

Thanks for the fine reports, fellows! Keep them coming to Kenneth R. Boord, 948 Stewartstown Road, Morgantown, West Virginia, USA. Good listening! - - - - - - K. R. B.

## NEW TV STATIONS ON THE AIR

The following new stations bring the lists published in previous issues up to date. VIDEO

STATE, CITY	STATION	CHANNEL	RANGE (IN MC.)	WAVELENGTH (IN FT.)	POWER*
Arkansas Little Rock	KARK-TV	4	66-72	14.61	100
California San Francisco	KSAN-TV	32	578-584	1.7	81
Florida Fort Myers Jacksonville	WINK-TV WJHP-TV	11 36	198-204 602-608	4.93 1.63	12 120
Georgia Augusta	WRDW-TV	12	204-210	4.79	117
Idaho Boise	KBOI-TV	2	54-60	17.8	16.5
Illinois Harrisburg	WSIL-TV	22	518-524	1.9	10.5
Michigan East Lansing Saginaw	WKAR-TV	60 5	746-752 76-82	1.32 12.74	245 24
Minnesota Duluth-Superior	WDSM-TV	6	82-88	11.8	100
Mississippi Meridian	WCOC-TV	30	566-572	1.73	251
New Hampshire Manchester	WMUR-TV	9	186-192	5.25	112
New York Schenectady	WTRI TV	35	596-602	1.65	262
North Carolina Wilmington	WMFD-TV	6	82-88	11.8	53.7
South Carolina Anderson	WAIM-TV	40	626-632	1.57	166.6
Utah Salt Lake City	KUTV	2	54-60	17.8	27.5
Virginia Danville	WBTM-TV	24	530-536	1.85	22.5
Wyoming Cheyenne	KFBC-TV	5	76-82	12.74	5.2
Alaska Anchorage	KTVA	11	198-204	4.93	3.22
Canada Montreal Vancouver, B. C.	CBMT	6 2	82-88 54-60	11.8 17.8	43.8 2.5

WJDT-TV, channel 3, Jackson, Mississippi, has changed its call letters to WLBT-TV.

\*From Station CP application.  $\dagger$ Educational, Michigan State College. The frequency of the video carrier = 1.25 + channel lower freq. limit. Total number of TV stations now on the air in U.S.: 369 (131 of which are u.h.f.).

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## A FEEDBACK LOUDNESS CONTROL

By RAY C. WILLIAMS Biophysics Dept., Medical College of Va.

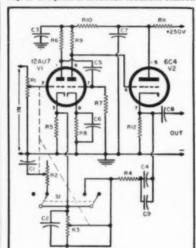
A low output impedance as well as high- and low-frequency compensation characterize this compact control.

OUDNESS controls which compensate for physiological characteristics of the human ear, as shown by the Fletcher-Munson curves, are considered a "must" by most high-fidelity enthusiasts

Such a control should have the following features: simplicity, compensation for both high and low frequencies, constant mid-frequency gain when compensation is switched in or out, continuous variability, and low output impedance. A loudness control which incorporates all of these features is shown in Fig. 1.

The basic circuit consists of a twostage resistance-coupled amplifier with cathode-follower output. A feedback loop consisting of  $C_2$ ,  $R_3$ ,  $R_4$ , and

Fig. 1. Diagram of feedback loudness control.



500,000 ohm linear-taper pot R. . 1000 ohm linear-taper pol 250,000 ohm audio-taper pot

-3300 ohm, ½ w. res. -1000 ohm, ½ w. wirewound res. R.-47,000 ohm, ½ w. res. -470,000 ohm, ½ w. res.

 $R_1$ —470,000 ohm,  $V_2$  w. res.  $R_1$ —1000 ohm,  $V_2$  w. res.  $R_{10}$ ,  $R_{11}$ —4700 ohm,  $V_2$  w. res.  $R_{12}$ —27,000 ohm,  $V_2$  w. res.  $C_1$ ,  $C_2$ —0.5  $\mu$ fd, 400 v. cond.  $C_3$ ,  $C_2$ —20  $\mu$ fd, 450 v. elec. cond.  $C_3$ —1  $\mu$ fd, 600 v. cond.  $C_3$ —1,  $\mu$ fd, 600 v. cond.  $C_3$ —2,  $V_3$  dec. cond.  $C_4$ —250  $\mu$ fd, 25 v. elec. cond.

-.25 µfd., 400 v. cond. -.01 µfd. ceramic cond. (shunt for C<sub>4</sub>) -D.p.d.t. switch -12AU7 tube

-6C4 tube

\* All three pots ganged into a single unit.

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 $C_{**}$  is connected between the cathode-follower output and the cathode of the input stage.  $C_*$  is a 20  $\mu$ fd., 150 v. electrolytic shunted by a .01  $\mu$ fd. ceramic condenser and is used for d.c. blocking only.  $C_{\circ}$ - $R_{\circ}$  give low-frequency compensation and when shunted by  $C_{\circ}$ - $R_{\circ}$  compensates for the high frequencies. The control element is a three-gang potentiometer and is made of the IRC type "Q" and multisections having the values indicated in the parts list.

When the control element is at the maximum clockwise position, C2 is shorted by Rs making the feedback loop resistive. Shunt condenser C. is in series with R2 and has little or no effect, the result being a two-stage amplifier having a flat frequency response. When the control element is turned counterclockwise, the reactance of C2 becomes increasingly large at frequencies downward from 1500 cycles. C. becomes an increasingly effective shunt at frequencies upward from 1500 cycles. The reduction of the feedback fraction at the low and high frequency ends, with the mid-frequency fraction remaining constant, results in a marked increase in gain at the low and high frequency ends of the spectrum. Obviously, varying degrees of compensation will be obtained when the control element is turned between these two extremes. Switch S. simply shorts C2-R1 and opens the circuit of the shunt condenser C, to make the feedback loop resistive, resulting in a flat amplifier.

In the maximum counterclockwise position the gain at 1500 cps is 14 db; at 30 cps is 38 db.; and at 15 kc. is 26 db. In the maximum clockwise position the gain from 30 to 15,000 cps is 14 db.

This loudness control can be incorporated into new or existing equipment or built as a separate unit. All grounds should be tied to a common point and the plate supply voltage should be well filtered.

#### REPAIRING TUNING SLUGS

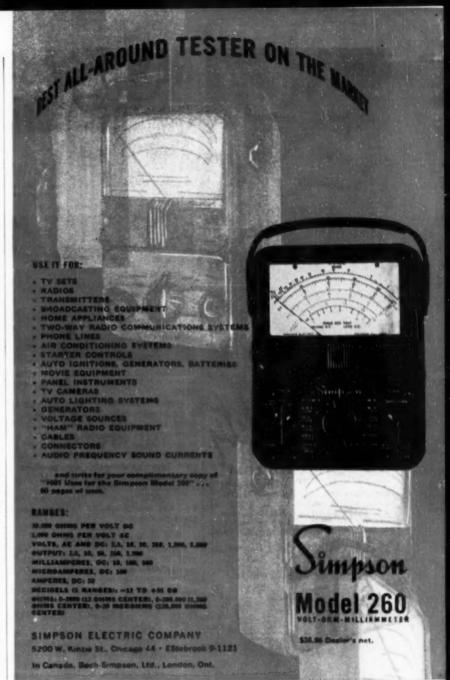
By CHARLES ERWIN COHN

THE screw slots on the tuning screws of slug-tuned coils are not usually very strong, and sometimes one of the nibs breaks off, making the slot useless. This most often happens when the slug turns hard, and a repair must be made to enable convenient tuning.

This can be easily done by first breaking off the other nib with a pliers and smoothing the end of the screw with a file. After that, a hex nut of the proper size is screwed on so that its surface is flush with the end of the screw, and solder is flowed on the end to hold the nut securely. Then the coil can be tuned with a socket wrench or "Spintite." –30–

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# NEW TV PRODUCTS on the Market.....

U.H.F. GENERATOR

Industrial Television, Inc., 369 Lexington Ave., Clifton, N. J., is now offering a u.h.f. television generator which is designed to speed u.h.f. set installation and service and provide



the required u.h.f. signal in locations where u.h.f. stations are not in operation.

The IT-130R uses the signal from a v.h.f. station and translates it to a u.h.f. signal on any channel. In using the equipment to demonstrate u.h.f. receivers when the signal is not available, it will permit customers to compare receiver sensitivity, ease of tuning, channel designation display, switching methods, etc.

Complete technical details on the IT-130R are available from the company on request.

#### NEW ANTENNAS

Channel Master Corporation, Ellenville, N. Y., has developed a new u.h.f. corner reflector, the Model 409. The new unit features optional 2-way mounting which permits the reflector to be mounted either behind or in front of the mast, depending on installation conditions.

Falcon Electronics Company of Quincy, Illinois, is now offering a new and improved version of the yagi for all-v.h.f. band use. The "88" has 5 elements on the low channels, 4 on the highs, and combines the best features of the conical with the high gain and sharp directivity of the yagi. Complete details are available on request.

JFD Manufacturing Co., Inc., 6101
Sixteenth Ave., Brooklyn 4, N. Y., has added two antennas to its u.h.f. line. The "Golden Rig" corner reflector is designed for fringe reception of channels 14 to 83. It is braced four ways to eliminate ghost-producing vibration. The second antenna is the UHF312 "Ultra Yagi" which has been designed for deep-fringe reception of single u.h.f. channels. The company will supply additional details on either of these antennas on request.

Technical Appliance Corporation of Sherburne, N. Y., is in production on a high-gain, all-channel colinear yagi for v.h.f. Tradenamed the "Trapper," it incorporates newly-developed phasing elements which multiply the effectiveness of the driven elements on high-band channels, according to the company. The antenna comes completely assembled.

#### HIGH-VOLTAGE CONTROL

Clarostat Mfg. Co., Inc. of Dover, N. H., is now offering a new highvoltage, high-resistance, compositionelement control, the Series 51.

Used to control voltage for electrostatic-focus television picture tubes, the Series 51 can be used with threegun tubes in color television.

Housed in a low-loss phenolic case with a phenolic disc back that separates the terminals for maximum insulation, the control withstands 10,000 volts d.c. breakdown test between terminals and mounting bushing. It measures 2" in diameter by \( \frac{5}{6}\)" deep. It is available in resistance values from 5000 ohms to 50 megohms linear and is rated at 1 watt.

Additional information is available in the company's Engineering Bulletin No. 119, which will be forwarded on request.

#### TV TEST EQUIPMENT

The Hickok Electrical Instrument Company, 10524 Dupont Ave., Cleveland 8, Ohio is currently introducing a series of test instruments designed to facilitate television servicing.

Among the new equipment is the Model 697 u.h.f. sweep alignment generator which provides fundamental output on all channels from 14 to 83. The generator features a piston-type attenuator which meets the most critical requirements for accurate attenuation. It provides minimum loading effects of u.h.f. circuits under alignment.



Technical details on this equipment are contained in Form 697 available on request

The company is also introducing the Model 690 u.h.f.-v.h.f. marker generator which covers frequencies from

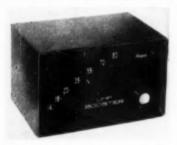
4.25 to over 225 mc. on fundamentals with a .25-volt r.f. output. It provides dual markers with any TV sweep generator.

The third item of equipment is the Model 691 heterodyned marker adder which is designed to be used with any sweep marker equipment that has an output of 50,000 microvolts or more. The Model 691 provides a marker visible at all times and will not change in amplitude or distort the response curve in any way.

#### BOGEN BOOSTER

David Bogen Co., Inc., 29 Ninth Avenue, New York 14, N. Y., has introduced a new u.h.f. television booster, the Model UHB.

According to the company, the new booster increases the reception range



for TV sets operating on channels 14 to 83 inclusive. A gain of 13½ db is obtainable at the lower frequencies while 8 db gain is available at the high end. The noise figure is 11 db at the low-frequency end and 15 db at the high end.

The Model UHB is housed in a compact case which has a vernier-type dial with a pointer behind a screened glass faceplate. A single knob controls the operation of the booster which is automatically turned on and off by the set by means of a thermal-type relay.

A data sheet covering this booster is available from the company.

#### COMPONENTS FOR COLOR

The Tube Department of Radio Corporation of America, Harrison, N. J. has announced that electronic components for color  $T\nabla$  will be available in production quantities soon.

Production schedules will be geared to meet the needs of manufacturers who are expected to produce an estimated 100,000 color receivers in '54.

Under present plans, seven of the more critical components will be produced initially. They include the deflection yoke, high-voltage transformer, and several types of focus and convergence coils, all designed to be used with the company's tri-color picture tube.

The components will be made at the firm's Camden, N. J. plant.

#### "MIRROR-BACK" TUBE

CBS-Hytron of Danvers, Mass. is in production on a new "Mirror-Back" picture tube, the 21FP4C.

This tube, which may be used to

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replace the 21FP4, is an aluminized tube with low-voltage, electrostatic focus. Electromagnetically deflected, it incorporates an all-glass, rectangular bulb, and a gray-glass, cylindrical face plate that provides greater contrast and a reflection-free viewing surface.

The 21FP4C has an electron gun designed for use with a single-field, external ion-trap magnet. It also has an outer conductive coating which, when grounded, serves as a high-voltage filter condenser.

#### U.H.F. HI-PASS FILTER

A u.h.f. hi-pass filter, the HP2, has been announced by Service Instruments Company of 422 South Dearborn St., Chicago, 1ll.

The new unit is designed to pass u.h.f. frequencies with less than 1 db



attenuation and reject all v.h.f. frequencies from 45 to 50 db. According to the company, the HP2 filter eliminates FM interference on u.h.f., airport interference on strips, i.f. feed-through, and prevents channel 5 or 6 from interfering on dual-conversion, all-channel tuners.

#### NEW PICTURE TUBES

The Tube Department of General Electric Company, Schenectady, N. Y., has announced two new 21" television picture tube types whose 90-degree deflection angles make them about 3" shorter than corresponding narrower-deflection types.

The tubes, types 21ACP4 and 21ACP4-A (aluminized), are both glass, rectangular types. Both tubes are 20" in over-all length, allowing in-

## COMPACT . INEXPENSIVE



#### Tracks 'em down dead or alive!

Amazing, new, indispensable electrical tester takes guess-work out of electrical troubleshooting. Signal light in tip at point of contact assures fast, accurate results. Popular, practical Desco Circuitracer... DEVELOPED FOR THE SERVICE MAN! Can be used to quickly locate grounds, opens and shorts in both dead and live circuits, ac or dc. Check these added features: Tests tube finament; plates, screens; vibrators and output voltages, relays, switches, fuses, controls. Tests condition of wiring and devices in all types of electrical systems, with power on or off.

Rugged, yet conveniently small. Weighs only 21/2 oz ONLY 53.95. Money-back guarantee. Order yours TODAY. (Jobber inquiries invited.)

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It is easy to learn or increase speed with an Instructograph Code Teacher Affords the quickest and most practical method yet developed. For beginners or advanced students, Available taxes from beginner a alphabet to typical messages on all subjects. Speed rance 5 to 40 WPM. Always ready-no QRM.

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## ULTRA LOW LOSS DESIGNED FOR HIGHEST UHF GAL

DON'T RUIN your installation with a lightning arrester of high insertion loss. Install the arrester that's an asset instead of a liability to your UHF or VHF installation—the JFD "3-IN-I" with the ultra low loss compensating coil circuit. Thousands of installations prove the "3-IN-I" gives the lowest insertion loss of any arrester in use today. Patented strain-relief lips and patented saw-tooth washers are exclusive JFD extras at no extra cost.

Write for Form 210.

U. S. Patent Nos. 2,654,857; D-159,330

JOHTNING ARRESTER

FD MANUFACTURING CO. BROOKLYN 1, NEW YORK 3 For UHF-VHF open wire

1 For all UHF or VHF tubular twin leads

2 For VHF flat twin leads

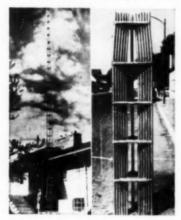
stallation in smaller cabinets than tubes with narrower deflection angles. According to the company, this feature also provides an increase up to 7 percent in screen area. The tubes also incorporate an external conductive coating which acts as a filter condenser when grounded.

The company will provide additional information on these two tubes upon request.

#### "STRATO-TOWER"

Spaulding Products Company, Box 126, Tipton, Indiana is now offering a new self-supporting tower with all-riveted construction.

An ingenious design allows the six sections of the tower to nest together so compactly that 100 feet of tower occupies warehouse space of less than 212 square feet. A complete tower



can be hauled in a station wagon or on top of a car as the knocked down package with all accessories is only 8 feet long and 20 x 20 inches at the

The tower is of steel, heavily-coated galvanized for longer life. It features all-riveted bracing with no welds to rust. No additional accessories are required to install rotators inside the towers and ne wrenches are necessary to assemble this tower.

For complete information and prices, write Department 101 of the company.

#### **COLOR TUBES**

Thomas Electronics, Inc., Passaic. N. J., has announced that it will mass produce 21" and larger color picture tubes by summer. Pilot operations are already underway and sample deliveries are being made to manufacturers.

The tubes are being manufactured under the Lawrence license and will be of the single-gun type. The company is the first licensee for these tubes in the eastern area.

#### COLOR TV RECTIFIERS

International Rectifier Corp., 1521 E. Grand Ave., El Segundo, California, has announced the availability of a series of selenium rectifier stacks for color television receivers.

The rectifiers in this series are de-



# **SURPLUS**

#### BC 233 TRANSMITTER

Use for Mobile or Ship to Shore, Uses Plug-in Coil unit for Frequency Rouge, Approx. 10 Watto Output with TX-17 Coil Unit. (2000 KC to 3500 KC: Less Power Supply, Eve. Cond...., \$49.95

#### DIAL DRIVE ASSEMBLY

Hallierafter This is the front end assembly part of Hallicrafter 8X-28 Receiver, Has main tuning and handspread shafts, Use for your own receiver or any precision tuning application. All New \$4.95

PE 94 INPUT FILTER dor Noise Filter Unit. Pl Setwe

#### BC 375 TUNING UNITS

TU-26 (200-500 KC), TU-6 (3000-4500 KC), TU-7 (4100-5200 KC), TU-8 (6200-7700 KC), TU-9 (7700-10000 KC), All with Vernier histologia, and Many useful parts.

Low Priced @ \$1.50 Ea.

POLE CLIMBERS 

#### BLOCK AND TACKLE

Brand New Heavy Duty Dicke Type 405, 2 Brocks with snap hooks and 25 Pt. of % Rope. All in original packages. \$3.95 5et

#### SPECIAL A.C. MOTORS

E. \$7.95

MIDGET SELSYNS

A) 6 type operates from 6-12 Volts 60 Cycle, Use as to u-dicating applications of 12 214224422 return shaft. All New (Appr. wt. 1 lb.) .... Bach \$1.95

#### ARMY AMMUNITION CANS



ARM 1
The M-3 50 Cal Cans 12" Long a wide x 712" then 150 Cal Cans 12" Long x 3.5.2"
Wide x 615" Beep All attantion with Leather Hardle and Hungel 7 on with least, Use for all your leads 0.1. Color, steam tack 51.50

NO.  BA-37 BA-37 BA-38 BA-38 BA-38 BA-38 CONTROL V Handy Talkie Batt. BA-38 CONTROL V Handy Talkie Batt. CONTROL V Handy Talkie Batt. CONTROL V Portable Batt.	8 .75 .25 .75	\$6.50 7.00 5.00
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		3000		0015	3.25
1500		006	1 50	001	3.25
.075		005	. 1.50	0008	3.25
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		.001		0002	1.75
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906	1.50	.00033	8.45	7500	٧.
005	1.50	0005	1.25	0005	3.95
		.0004	- A 40	****	**
003	1.25	00025		8000	W
.00275	1.25	.0001		01	5.95
.0025	1.25	.00009	1.10	0006	4.50
.00125	1.00	0.0004	1.00	0005	4.50
00003	1 00			00035	3.00

## FIG. B SCREW TERMINAL 022 2 85 015 2500 V 022 85 015 016 01 02 85 01 004 01 75 004 001 85 003 005 50 002

1250 V.

## FIG. C. SOLDER LUG. TYPE

75 005 65 02 1250 V. 75 600 V 00005 75

#### HEAD SETS

HS-23 High Impedence R-14 Phones 8000 Ohm, For all standard Radio Output Circuits. All New. \$2.50 Ea

#### TRANSTATTS

5 KV, 45 Amp. Variable Voltage Output Transformer, Input 115 V., 60 Cy, Output 0-130 Volts, All New \$59.95

#### 250 TL TUBES

Here is a long awaited Buy for the Power have a limited quantity available. @ \$8.95 Ea., 2 for \$16.00.

#### SIGNAL GENERATORS

SIGNAL GENERATORS
Type 1-72 A, Range 100 KC to 32 MC in 5 bands,
Operates from 115 V, 60 Cy., AC Ideal for
Radio Servicing. All Used but checked out in
\$24.95 Ea.

RADIO DIRECTION FINDER RADIO DIRECTION FINDER BC-1002 Receiver. Frequency Range 1000 RC in 2 bands. Has beops mount with Sense and Balance Circuits, L supply. In Esc. Cond. with Tubes.

#### 549.95 Fa

12 VOLT DYNAMOTOR PE 133 Dynamotor, for above receiver, Volts or 3 Amp., Output 230 Volts D MA. All New Mounted on Filter Base. . 1 e. Input 12 .56.95 Ea

TELESCOPIC ANTENNA
Feet Long to 3 sections. Used for shile Antenna. All New Packaged r Portable

24 VOLT FAN MOTOR

Delca Motor, Approx. 2\*, long x 1\*, Diameter,
Reversible with Fan attached. All New Pack\$2.98 ±.

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to used as sound power phones external few hundred feet well-out any external few hundred power phones never \$1.00 PAIR

#### 12 or 24 VOLT VIBRATOR INVERTER

Volts D.C. hoost, 110 V. 60 cycle, 240 wat n \$27.50

## For Mobile or Light Airplanes, in original factory braces. Weight: 37 Lbs., Size: 3.12° wide x 10° long x 10° high. Signat Corps Type BB-53, 12 Volt. 34 AH.

A real terrific surplus value \$9.95 e they last, all new .... Ea.

NEW 12 VOLT BATTERIES

HEAVY DUTY 12 VOLT BATTERIES or 12 VOLY 220 AMP. HOUR Hattery, Use for tithin Boats, Hos. Montle Hadio, All New 529.95 Ea. 12 VOLT. 68 AMP. HOUR But cars or Mobile Radio with Spill Dry Charged \$14.95 Ea

# Thousands! CRYSTALS Thousands!

#### SOUND POWER HANDSETS

## ..... Per Pair \$18.95

SOUND POWERED HEAD AND CHEST SET one was as Hand Set except you have freedom of No flatteries or power source required for ap-tion by the control of the co

CAPACITORS | FIXED | OIL FILLED | Soldy | Pyrame | C D. | Etc. |
Soldy | Pyrame | C D. | Etc. |
ALL D. C. VOLTAGE | MATINGS |
D. 400 V | 30.78 | 1 MFD | 1000 V |
D. 400 V | 2.98 | MFD | 1000 V |
D. 600 V | 7.5 | 10 MFD | 1000 V |
D. 600 V | 1.98 | 1 MFD | 1000 V |
D. 600 V | 1.98 | 1 MFD | 1000 V |
D. 600 V | 1.98 | 1 MFD | 1000 V |
D. 600 V | 1.98 | 2 MFD | 1000 V |
D. 600 V | 2.98 | 2 MFD | 2000 V |
D. 600 V | 2.98 | 3 MFD | 2000 V |
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D. 600 V | 2.98 | 3 MFD | 2000 V |
D. 600 V | 2.98 | 3 MFD | 2000

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A LARGE STOCK OF ARC-1, ARC-3, ART-13,
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RC-348, BC433G, RC-611, BC-1306, CRT-3, 156A, 1222, TE-19A, TE-35A, TE-36A, 8CR-284, 8CR-522,
SCR 578, SCR 625 TCS, T19/APQ5, TS-34/AP,
TS-100/AP, TS-184/AP, 14C, Plugs and Sel-
syns
Kay Elec. Mega-Sweep
Kay Elec, Mega-PipperExc, 100.00
Boonton Q Meter 160A 50KC, to 75MC Exc. 409.50
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a view a series deposit a comment.

NEW SPRING CATALOG NOW AVAILABLE

## HOTOCON

417 N. Foothill Blvd. SVcamore 2-4131 Pasadena 8. Calif. RYan 1-6751 CABLE: Photocon, Pasadena.

signed for capacitive loads of 600, 700, and 750 ma, and are produced for maximum input voltage ratings of 130. 172, and 195 volts r.m.s. The construction of this series differs from regular radio and TV selenium rectifiers.

A bellows-type spring contactor, as used in industrial rectifiers, is employed in the assembly of this series. This contactor affords a lower forward drop, lower temperature rise, and longer life, according to the company.

Bulletin ER-178 Supplement covers the electrical and mechanical specifications on all of the units in the series and is available on request.

#### "UHF-LAMP"

Metal Products Corporation, 807 Northwest 20th St., Miami, Florida is now offering an all-channel, indoor



u.h.f. antenna enclosed in a table lamp which is designated as the "UHF-Lamp.

The antenna-lamp comes in a variety of color combinations and gives a subdued light for television rooms. Tests made in five south Florida cities have shown that the antenna-lamp gives good reception in favorable locations up to five miles from low-powered u.h.f. TV stations.

The company will provide additional details on this and other antennas in its line upon request.

#### REPLACEMENT FLYBACKS

The Standard Division of Chicago Standard Transformer Corporation, Addison and Elston, Chicago 18, Illinois, has added three exact replacement flybacks for Sulvania receivers.

The new units, A-8227, A-8228, and A-8229, cover almost 90 per-cent of all Sylvania production up to 1953. They are supplied as coil and core for quick, easy installation to the original brackets which are a permanent part of the chassis. New filament leads are packed with each transformer.

Stancor Bulletin 478 lists over 170 Sulvania models and chassis using these transformers. It is available without charge from the company's distributors or the company direct.

#### TRANSMISSION LINES

Fenton Company. 15 Moore St., New York 4, N. Y., has introduced two new transmission lines designed to provide better TV reception by reducing interference pickup.

Known as "Fentube-Airspaced" and "Twistube," the new lines have one plain and one Formvar-coated pure copper conductor. The former has one common covering tube which is firmly fused to the spiral cords. Since there is practically no dielectric between conductors, all of the advantages of an open wire line are incorporated with-

out its disadvantages.

The "Twistube," besides being airspaced, incorporates the added feature of being transposed to equalize the average proximity and thus the capacity of both conductors in relation to the mast and other grounded objects.

#### SIGNAL EQUALIZER

Tele-Matic Industries, Inc., 1 Joralemon St., Brooklyn, N. Y., has introduced an automatic signal equalizer designed for locations where the signals from the low-frequency channels cause overloading and the high-frequency channels are not strong enough to tolerate any attenuation.

The Model AT-25 provides maximum attenuation of the low-frequency channel and minimum attenuation of the high-frequency channel without upsetting the impedance of the receiver.

#### TUNER REPLACEMENT KIT

Standard Coil Products Co., Inc. has announced the availability of a new tuner replacement kit which contains the small tuner parts which may be needed by the service technician.

Included are 104 of the most-called-for parts for servicing TV-200, TV-1500, TV-2000, and TV-2200 series tuners made by the company. The majority of parts are individually boxed, permitting the distributor to place the contents in stock or to sell the kit as a complete item to his service trade.

#### CHANNEL SELECTOR

Tech-Master Products Co., 443 Broadway, New York 13, New York, has announced (Continued on page 142)



#### TOWERS OF STRENGTH TO LAST A LIFETIME

Self-supporting tower built up of galvanized steel sections. No guy wires necessary. Easy to erect. Safe and resistant to high wind. Available in heights 47 ft., 60 ft., 73 ft., 87 ft., and 100 ft., with bases in proportion.

#### FRINGE AREA TV BUYERS MUST HAVE SPECIALLY BUILT TOWERS FOR CLEAR RECEPTION

Tower and the TV set go hand in hand as a package sale to rural TV buyers. Provides an extra sale and profit to dealers. An excellent fast selling accessory for jobbers and dealers.

#### TERRITORIES OPEN FOR JOBBER DEALER FRANCHISE

Write for complete structural details, packing, prices, discounts, and territorial assignment.

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## AERMOTOR

Dept. 6103, 2500 Roosevelt Road, Chicago 8, Illinois **RUILDERS OF STEEL TOWERS SINCE IRRR** 



There is an ATR INVERTER There is an ATR INVERTER for most applications for inverting D.C. Voltages (ranging from 6 voits D.C. to 220 volts D.C.) to 110 volts A.C.... Specially Designed for operating A.C. Radios, Tape Recorders, Wire Recorders, Dictating Machines, Electric Rasors, Record-Changers, Television Sets, Amplifiers, Address Systems, Radio Test Equipment and most small electrical and electronic devices Systems, Radio Test Equip-ment and most small elec-trical and electronic devices FROM D.C. VOLTAGES IN AUTOMOBILES, BUSES, TRUCKS, SHIPS, TRAINS, PLANES AND IN D.C. DISTRICTS.

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Bachelor of Science Degree in 36 months.

Major in Electronics or Power. Now, prepare for a career in these rapidly expanding fields.

This school will prepare you to become an engineer, technician or service man. Previous military, academic or practical training may be evaluated for advanced credit.

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In 12 months you can attain the Radio-Technician's certificate. An added 6 months course qualifies you for the Radio-TV Technician's certificate and the Degree of "Associate in Applied Science." The Technician's course is the first third of the program leading to a Bachelor of Science Degree in Electrical Engineering with a major in Electronics.

Also offered: 12-month Radio-TV service course; 12-month Electronics or Electro Technician Courses; 6-month Electrical Service Course and 3-month refresher and general preparatory classes.

#### Terms Open April, July, Sept., January

Famous for its Concentric Curriculum. Faculty of specialists. 50,000 former students. Annual enrolment from 48 states and 23 overseas countries. Non-profit. 51st year, Courses approved for Veterans. Residence courses only.



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I am interested in name of course

Name Age.

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If veteran indicate date of discharge.

that owners of any 630-type television receiver as well as owners of the company's Models 2430, 2431P, 2430-9, 1930, and C-30 sets, can obtain full 70station u.h.f. coverage with these receivers by means of a newly-introduced u.h.f. selector.

The Model TV101-U fits into the front recess that is common to all 630-type chassis, thereby requiring no cabinet alterations. Mounting is simple, requiring only two internal connections and the antenna lead. One knob, continuous-tuning covers the entire u.h.f. spectrum.

#### ANTENNA "ORIENTOR"

Mosley Electronics, Inc., 8622 St. Charles Rock Road, St. Louis 14, Mo., has designed a new aid for TV installers which facilitates u.h.f. and v.h.f. antenna orientation.

Called the "Orientor," the new device consists of two pocket-size units comprising an isolation network that permits the single transmission line to carry the signal to the television set and return the video signal without interaction and with little or no insertion loss.

The video signal can be read in terms of relative strength by means of a portable v.o.m. In this way the in-



staller on the roof can tell when the TV set is achieving maximum video signal.

Installers are invited to write for a descriptive folder, Form 903. Address all requests to the company direct.

#### NEW STANDOFF INSULATOR

A new strap-type standoff insulator that accommodates all standard television transmission lines has been an nounced by *Insuline Corporation of America*, Long Island City, N. Y.

A low-loss polyethylene grommet in the eye of the device holds flat twinlead ribbon, tubular twin-lead, ovaluar lead, or coaxial cable securely. An adjustable steel strap permits the insulator to be used on any pipe from  $\frac{3}{4}$ " to  $1\frac{1}{2}$ " in diameter. The assembly is quickly tightened by means of a captive tension nut, through which the threaded end of the insulator screweye passes. All metal surfaces are heavily zinc plated.

#### FLYBACK CHECKER

Radio City Products Company, 152 W. 25th St., New York, N. Y., is now offering a new instrument for testing the condition of flyback transformers and yokes in the horizontal output circuit of TV receivers.

Known as the Model 123 "Flybacker," the new unit detects a single shorted turn or a number of shorted



turns in both flybacks and yokes. It also shows up short-circuited windings. A large front meter indicates, on a "good-bad" scale, the condition of the unit.

#### "SILVER ROCKET" 630 CHASSIS

Mattison Television and Radio Corp., 10 West 181st St., New York 53, N. Y., is now in production on a new 630 chassis which features "synchromatic" tuning.

The new tuning feature was designed to synchronize picture and sound with co-channel circuits. Picture and sound tended to drift apart in extreme fringe areas or on the new u.h.f. channels. The viewer can now tune for the best picture and the sound is adjusted automatically.

The company will forward a booklet on this and other new chassis in the series upon request to the engineering department of the company.

#### TY LINE INSULATOR

JFD Manufacturing Company, Inc. of Brooklyn 4, N. Y. has introduced a new standoff insulator which has been tradenamed "PAL."

Designed for u.h.f. requirements, the new insulator eliminates the necessity



of removing the grommet from the standoff or threading the lead-in through the grommet.

Electrically, this insulator maintains the critical distance between lead-in and metal standoff which prevents impedance mismatch. The new-design insulator is available in every type of the company's standoffs.

—30—

#### Looking Ahead

(Continued from page 43)

his new color television receiver. The importance of this is emphasized by one manufacturer who says his threegun picture tube can be damaged if the chroma (color) control is advanced too far on a strong signal.

Since all these practical considerations may change as set designers whip production models into shape, the important thing to spend time on now is color fundamentals. What are colors? How is a full color picture formed on the face of a color tube? Of what does the composite signal consist? How do these signals flow through a basic set? These are the questions a good technician will try to answer even before he gets to see a color set.

Much material is being published on color these days. If the service technician doesn't choose his study material carefully he runs the risk of becoming more confused than enlightened. Don't spend too much time with authors who seem more intent on dazzling you with their brilliance rather than work sufficiently hard in presenting their material so you can understand it.

The color system, when understood, will be simple to you. If you choose carefully the material you study it won't be too difficult to absorb.

Color sets will probably be available in limited quantities for consumer purchase this fall. At first, we can look forward to direct interest and even some control of service on the part of some manufacturers. But then there is no doubt that, as time goes on, color receivers, just like their black-and-white brothers, will be serviced principally by servicing dealers and independent service technicians. First there will be an increase in service contracts—then a levelling off.

What with color, hi-fi, tape recorders, and the additional growth of u.h.f. and new markets, the service technician can look forward to a busy and exciting future. I hope you get your share of the rewards.

#### U.H.F. Antennas

(Continued from page 58)

completed, mount them on the 1¼" diameter aluminum tubing. Space the assemblies one above the other according to the dimensions shown on the chart. Two straight lengths of #14 tinned copper wire are used to connect the driven elemen's only, as shown.

Attach the 300-ohm lead-in as shown at the exact vertical center of the two copper wires. Be sure to seal the open end of the hollow lead-in wire or you may find water running out of your set or converter some rainy night. When all the joints are tightened and all soldering completed, spray the entire antenna with plastic spray or varnish it with waterproof varnish.



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#### TV Test Equipment

(Continued from page 49)

large number of spurious outputs, the operator will note few spurious markers on the r.f. response curve.

Spurious markers are especially troublesome when running video amplifier response curves, because numerous harmonics of the marker generator fall within the video passband when the curve is being marked at lower frequencies. For this reason, absorption markers are used to a considerable extent in video amplifier checks. Some sweep generators have absorption marking facilities built in.

#### Volt-Ohm-Milliammeters

The volt-ohm-milliammeter, or v.o.m., is basically a simple instrument, but is nevertheless the backbone of many a service operation. The v.o.m. is surpassed in usefulness only by the vacuum tube voltmeter.

Circuit loading is a problem in v.o.m. application, and in this respect, the 20,000 ohms-per-volt instrument is superior to the 1000 ohms-per-volt meter. In turn, the 100,000 ohms-per-volt v.o.m. imposes the least circuit loading of any nonelectronic voltmeter.

The prime consideration in choosing a volt-ohm-milliammeter, aside from circuit loading, is the accuracy of indication. In this regard, it is a fairly good rule that one gets what he pays for. The higher priced instruments utilize meter movements with higher full-scale accuracy, and the multiplier resistors are manufactured to higher tolerances. A typical medium priced instrument may have a full-scale accuracy of  $\pm 2\%$ , and multiplier resistors with a tolerance of  $\pm 1\%$ . The end result is a full-scale accuracy of + 3%.

The beginner sometimes falls into the error of assuming that if the fullscale accuracy is ±3%, any voltage value indicated on the scale will be accurate to within this tolerance. Such an assumption is completely false. An example will illustrate the fallacy of this argument: If the voltmeter is operating on the 100-volt range, the full-scale accuracy of the meter will be ± 2 volts. When the pointer reads full scale, or 100 volts, it is true that the accuracy of the meter movement is within ± 2%. But consider the situation in which the pointer reads 25 volts on the 100-volt scale; the accuracy is still ± 2 volts, which means that the true voltage falls somewhere between 23 and 27 volts but this is an accuracy of only ±8%! The advisability of using a voltmeter on the lowest possible range is apparent.

Isolating probes cannot be used successfully with a v.o.m., because the relatively large current drain of the instrument entails excessive loss of voltage across the isolating resistor. Furthermore, an isolating resistor which is chosen to provide direct readings on one range, will read incorrect-

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ly on the next higher range, because the input resistance of the instrument is not constant. The input resistance on any one range is equal to the full-scale value of the range times the ohms-per-volt rating of the instrument; for example, a 100,000 ohms-per-volt instrument has an input resistance of 1 megohm on the 10-volt range, but an input resistance of 10 megohms on the 100-volt range.

#### The V.T.V.M.

Most v.t.v.m.'s have automatic protection against burnout, which avoids severe damage to the instrument when applied across excessively high voltages. Aside from this important feature in practical work, a v.t.v.m. provides high input resistance on lowvoltage ranges, which makes it possible to measure a.g.c. voltages, signal-developed grid bias, and platevoltage values in pentode amplifier circuits. Almost all service v.t.v.m.'s are designed with an isolating probe for use on the d.c. ranges, so that d.c. voltages can be measured in the presence of high-frequency a.c.

The input resistance of a v.t.v.m. is constant (usually at 10 or 15 megohms) so that when a high-voltage d.c. multiplier probe is used with the instrument, the probe can be used on the low-voltage ranges as well as on the high-voltage ranges. Thus, a v.t.v.m. can be used not only to measure the second anode voltage of a picture tube, for example, but can also be used to measure relatively low d.c. voltage values in the presence of highvoltage a.c. pulses, such as the plate voltage of a horizontal oscillator tube. In the latter application, the highvoltage d.c. probe is being used as an a.c. filter, and the d.c. voltage attenuation is incidental; because of the constant input resistance provided by the v.t.v.m. the probe reads directly on any scale, indicating 1/100 of the applied d.c. voltage.

Many present-day service v.t.v.m.'s provide for measurement of peak-to-peak voltage values. Some instruments have a built-in peak-to-peak voltage indicating network, while others obtain peak-to-peak indication by means of an external probe. The built-in arrangement has an advantage in that higher voltages can be accommodated without damage to the instrument, but has the disadvantage that the input capacitance is somewhat higher, with correspondingly greater circuit loading.

The ohmmeter function of the electronic ohmmeter built into the service v.t.v.m. is superior to that of the v.o.m., since resistances as high as 1000 megohms can be measured with an ohmmeter battery of only 1.5 volts. This is a great advantage, since various delicate circuit components can be damaged by higher voltages.

The accuracy of a v.t.v.m. is seldom as high as that of a v.o.m., but against this, are the advantages afforded by electronic protection against overload, and wider measuring facilities. —30—

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#### Electronic Key

(Continued from page 81)

make it necessary to increase or decrease this resistor for a correct twoto-one ratio. The higher the value of Rz, the greater the dash-to-dot ratio. The value of R<sub>2</sub> shown in Fig. 3 gave a two-to-one ratio as determined by an electric counter. The ratio can be determined fairly close by ear, or by slowing the key down so that dots and dashes can be counted. Experience has shown that for correct adjustment, the ratio should be determined by counting rather than by listening to the relay clicks or an oscillator.

The photographs show the general construction procedure followed. Although the parts were mounted in a 4" x 5" x 6" metal box, a 5" x 7" x 3" aluminum chassis would be easier to drill.

In the photograph of Fig. 1 the speed control,  $R_s$ , was mounted to the left of the 2D21. The "weight" and balancing control, Rig. was mounted to the left of the 12AU7, V2. The cathode potentiometer was mounted below V2. In order to accommodate the three wire connection to the "bug," a three way plug and jack were used. The jack,  $J_2$ , is mounted to the right of the "on-off" switch, and insulated from the chassis.

The photograph of the "bug," Fig. 2, shows the three-conductor cable fastened to the spring arm stop with a cable clamp. The connection to the dash contact post is made below the bug after the strap from the dash contact post to the dot contact post was removed. By loosening the dot contact post, enough clearance between the metal washer and the stud can be obtained to accommodate a solder lug. To keep the spring arm from bouncing when dots are being made, a rubber band was used to keep the end of the spring arm against the spring arm stop. Only the necessary "bug" modifications are shown, and the reader will undoubtedly have ideas on how to adjust his own "bug." However, for a better "feel" the spacing between contacts should be closer than normally used with a "bug."

The circuit can be easily adjusted by using a vacuum tube voltmeter and an ohmmeter, or combination test instrument.

First, hold the "bug" lever to close the dot contact, and connect the v.t.v.m, between the cathode of  $V_{zz}$  and ground. Adjust the speed control potentiometer, R., until a varying voltage is noticed on the meter. Set the speed control so that the meter pointer is nearly steady. Note this value.

Next, place the v.t.v.m. across the cathode of  $V_{zB}$  and ground. The dot contact should still be closed. Adjust R, to give the same average voltage as before

Release the "bug" lever and connect the v.t.v.m. across the relay winding with the positive meter terminal to the plate end of the relay winding. Adjust the balancing potentiometer,  $R_{\rm m}$ show zero voltage across the relay. Momentarily ground the grid of  $V_{28}$  and note the voltage.

Close the dot contact and adjust R. until half of this reading is obtained. The relay may not operate at this time.

Set the v.t.v.m. or ohmmeter to indicate Rx10, Rx100, or Rx1000 and calibrate it in the usual manner. Connect the ohmmeter across the armature and keying contact of the relay. Hold the dot contact closed as before and adjust the relay to give mid-scale indication on the ohmmeter. This generally will insure proper adjustment of the relay. Now close the dash contact on the "bug" and note that the ohmmeter indicates about three-quarters full scale or three-fourths of the way toward the "zero ohms" end of the scale. Rechecking the voltages and rebalancing, as described, will insure that proper adjustments have been made.

If the relay is a non-adjustable type, use the "weight"-balance control,  $R_{10}$ , to give the mid-scale indication.

If the dash-to-dot ratio is too great, a lower value of resistor should be tried between the grid of  $V_{zA}$  and the timing condenser. Due to the circuit elements in the keving circuit of the transmitter, the "weight" control, Rio, should be used in adjusting the transmitted signal

#### Relays

Voltage readings under various conditions for four different types of relays are shown in Table 1. These readings were obtained after each relay was connected in the circuit and adjusted as previously described. The voltages shown in the chart, which should be the same, will vary one or two volts depending upon the power line voltage at the time the readings were taken.

The relay marked "BK-35," which was found as a surplus item, is ideal for this circuit, but three others were also checked for performance and ease of adjustment. The Ward Leonard relay was purchased about seven years ago, but could not be found in any of the present day catalogues. However, a catalogue number 25038 marked on the relay might be helpful in locating a similar one from the manufacturer. Since it is constructed along the same lines as the "BK-35" relay, it is easy to adjust the contact spacing and spring tension. On the other hand, the only method of adjusting the contact spacing on the Potter & Brumfield type LM5 is to bend the back contact down with a pair of pliers. The amount of bend required is shown in the photograph of Fig. 4. The spring tension is adjusted by means of a screw at the top of the relay. The distance between the armature and the pole piece should be about the thickness of a sheet of good-grade typewriter paper for best results. After a few repeated adjustments, this relay worked as well as the others. The Western Electric relay is a sealed, non-adjustable type, polar relay which fits a standard octal socket. Since it is sealed-in-glass mercury con-

tact switch whose characteristics are fixed by its design and manufacture, no adjustments are necessary for keying purposes. It was included in the list to show that a non-adjustable type relay having a medium coil resistance would work satisfactorily. However, the relay should be a sensitive plate relay with a winding of from 2000 to 12,-000 ohms.

The circuit shown was designed for economy, low supply voltage; a minimum of parts; and ease of adjustment. The low priced semi-automatic key was purchased from the Electric Specialty Mfg. Co., Cedar Rapids, Iowa. As long as the plate voltage does not vary over 10% higher or lower (20% total) the "weight"-balance control, R.o., and the speed control will adjust the circuit for different voltages. The only reason for using the 2D21 instead of the larger 2050 was to conserve space.

In closing, the writer wishes to thank W5FRE for his assistance in the con--30struction of the keyer.

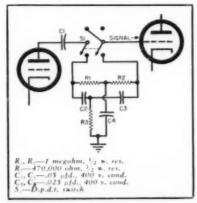
#### RUMBLE FILTER By DAVID KESSEL

THE current trend toward improved low-frequency response in amplifiers and speaker systems has resulted in a corresponding increase in the audibility of so-called turntable rumble. This is especially true of the average system in which a three-speed changer and a loudness control are used.

The most economical method of reducing response below 40 cycles is the insertion of a parallel "T" section beinsertion of a parametric tween the equalizer tube and the next (high impedance) stage. Unfortunately the mathematics involved in the computer for the "F" tation of circuit components for the filter seems to discourage many experi-

The author has tested several "T" filters and found that a circuit with a resters and found that a circuit with a res-onant frequency (frequency of mini-mum response) of 8 cycles eliminates practically all of the Garrard and Webster-Chicago rumble with little ef-fect on frequencies above 40 cycles. The response is down 5 db at 25 cycles; 20 db at 10 cycles; and 20 db at 5 cycles. Apparently most rumble occurs between these frequencies. If this filter is connected in the preamp with a d.p.d.t. switch, the decrease in speaker vibration with the filter switched in is immediately noticeable.

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#### Communications Receiver

(Continued from page 67)

permitting use of a wide variety of headphones. The speaker is silenced when the headphones are inserted into the jack. A larger external speaker, with an impedance of 4-8 ohms, may be plugged into the headphone jack if so desired.

Two slide-rule tuning dials are used, one the main tuning dial and the other the bandspread tuning dial.

The main tuning dial has four scales marked "A," "B," "C," and "D" corresponding to the four bands of frequencies tuned by the NC-88, the position of the red dot on the "selector" switch indicating which of these scales is to be read. Heavy white lines have been placed on certain portions of the short-wave bands corresponding to important frequencies along with a letter to designate the agency which uses each. That is, the letter A above a heavy white line indicates a band used chiefly by amateurs, while the letter F denotes use by foreign countries, the letter S, ships, and P, police. There are also small white circles at various points on the scales enclosing an identifying number or letter. These circles indicate the correct setting of the main tuning dial pointer when bandspread tuning is to be used on that band. They are discussed in the paragraph on bandspread tuning. The two circles enclosing the letters CD on the broadcast band, however, indicate the two civil defense frequencies and are dealt with in the paragraph on those frequencies.

The "bandspread" dial has five scales calibrated directly in mc. plus a logging scale graduated from 0 to 100. These scales are identified by a letter to indicate the receiver band to be used for a particular amateur band and a number to indicate the amateur band being tuned, with the exception of the logging scale which is identified by the word "log." Six principal amateur bands have been calibrated on the dial, the "log" scale serving for calibration purposes on any other band within the range of the receiver.

Recently the Federal Communications Commission authorized the frequencies 640 and 1240 kc. for use by broadcast stations in the event the United States should be placed under threat of air attack. In that event all transmitters will be required by law to immediately cease all operation, with broadcast stations resuming operation only on those two frequencies. Accordingly, these frequencies have been clearly marked on the "A" scale of the NC-88 and are identified by circles enclosing the letters, "CD." To receive either of these two frequencies place the receiver in operation for the broadcast band and set the bandspread pointer on the "set" mark. Then set the "main tuning" dial pointer in the center of either of the two circles and the receiver will be set up for proper reception of emergency bulletins. -30-

#### TV Troubleshooting Methods

(Continued from page 65)

good, but what if it doesn't work? For example, what if signal tracing shows all of the stages of the suspected section to be all right? We may have suspected an innocent section: signal trace other sections which could possibly be guilty and, as a last resort, signal trace the supposedly "innocent bystanders."

What if all of the components in the suspected stage check all right? You guessed it: check the components in

other related stages.

Why not just check all of the components and adjustments in the receiver on every job and forget all about the systematic procedure? It may be all right in theory, but what good is it if it may not always work? The answer is that it does work often enough to save most of the time which would otherwise be spent on random checking of components and adjustments. Also, it can be combined with the other two techniques previously mentioned.

Faults which occur frequently enough to be worth checking on even without any definite indication are: bad tubes, blown fuses, and poor connections in the antenna system. These things can also be included among those easy to check, along with visible faults such as broken components and open or shorted wires, and the effects of manipulating the various controls and adjustments, of tuning to a different channel, or of operating the receiver at a different time or in a different location.

A practical troublefinding procedure should include steps such as the following, subject to modification depending on the indications observed and the available equipment:

1. Have set-owner demonstrate and describe trouble.

2. Observe effects of front-panel controls and adjustments. (Any adjustment whose manipulation does not produce an improvement should be returned to its original position.) Check back-of-chassis adjustments, antenna connections, and anything else accessi-

3. By functional analysis, determine section probably faulty.

4. Remove back cover, insert a.c. interlock bypass ("cheater" cord). Adjust ion trap magnet. (They usually need adjustment.) Check whether all tubes are lighted. Refer to tube location guide and replace tubes in suspected section. If no replacement parts except tubes are immediately available, check other tubes.

5. If vacuum tube voltmeter, testpoint adapters, and replacement parts other than tubes are available, make voltage and resistance measurements from top of chassis in suspected section and compare with service data. Refer to circuit diagram to determine component probably faulty.

6. Take chassis out of cabinet and to shop. Refer to hints regarding the

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receiver and trouble at hand, if any are available from published data or your own records. Continue signal tracing and component checking if nec-**OSSATV** 

7. Make record of receiver type, symptoms, and cause, so that you will have a hint available next time.

This procedure should be supplemented by a few precautions:

1. Do not change permanently any component or adjustment unless the benefit is immediately obvious.

2. Do not correct any trouble without giving some thought to what may have caused it, especially in a case of burned-out fuses, transformers, resistors, tubes, etc.

3. Do not be sure that a change in a component or adjustment has removed the actual cause of a trouble unless you understand how it could have done so

#### Electro-Voice Model 666

(Continued from page 63)

trum for which it is designed and, by proper acoustic delay elements, a crossover from one acoustic path to another is achieved smoothly and uniformly. This principle of varying the front-to-back distance is now established as the "Variable D."

The Model 666 is unique in that "boominess" is totally absent on close talking. Variations in bass sensitivity

below 100 cps due to the proximity effect are less than ± 2 db when the unit is used from 6 inches to 5 feet. Close talking is facilitated by the insensitivity of pressure-operated dynamic elements to "blooping" from explosive labial sounds, such as those found in the letters "P" and "B." Complete insurance against excessive blooping is effected by the integral blast filter. The blast filter obviates the necessity for wind bags on exterior shots.

This freedom from blooping and proximity effects allows the microphone to be used closer to the vocalist, announcer, or soloist for still further discrimination against unwanted sounds than would be possible with a conventional unidirectional microphone. -30-

#### TV CONFERENCE

THE Eighth Annual Television Conference, sponsored jointly by the Cin-cinnati Section of the IRE and the Professional Group on Broadcast and Television Receivers, will be held in Cincinnati on Saturday, April 24th.

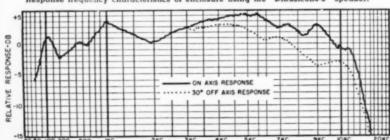
The subject of the conference will be "Black and White and Color TV and UHF." Meetings will be held in the Engineering Society of Cincinnati Bldg. at McMillan St. and Woodburn Avenue.

Advance registrations for the confer-ence, including hotel, luncheon, and banquet reservations, should be ad-dressed to J. A. Purdy, 7520 E. Miami River Road, Hamilton, Ohio. Others may register at the Conference if desired.

#### "Diffusicone-8" Enclosure (Continued from page 55)

plywood paneling with all sections well glued and screwed. Internal damping is provided by "Kimsul" insulation.

This cabinet has created such wide interest during public demonstrations that it has been exhibited without the decorator's finishing touch (as in the photograph) in order to satisfy the countless listeners that there was only one 8-inch speaker working during the demonstration. The home constructor will of course want to put the finishing touches to the cabinet as best suits his needs. The important factor concerning the acoustics of this finish is the grille cloth that covers the face of the speaker. The University "Diffusicone-8" employs the patented highfrequency diffusing element which disperses the high frequencies over a wide angle. Thus, whatever grille cloth is used should be selected more on the basis of acoustic transparency rather than artistic appearance. A good rule of thumb to use in selecting a grille cloth is that the cloth be about 50% optically transparent. If these precautions concerning the physical construction of the cabinet are followed, then the combination of the enclosure and the "Diffusicone-8" will give clean strong bass reproduction with well balanced middles; and if the proper grille cloth is used the top end of the spectrum will be completed through the extended-range, wide-angle, high-frequency performance of the diffusion system.



FREQUENCY-CPS

#### Certified Record Revue

(Continued from page 76)

lapse while conducting the Israel Philharmonic recently. It is typical of the man that he drive himself to a state of exhaustion in his striving for perfection. The same relentless spirit is evidenced in his reading of these Mozartian gems. There are some who may object to a "big hall sound" for Mozart. I don't think this argument is valid here because the spaciousness of the recording is coupled by a fabulous amount of inner detail. I don't think I am exaggerating when I say that this is perhaps the finest sounding Mozart on records. The silken beauty of the strings, the bubbling capriciousness of the clean and articulate woodwinds are a joy to the ear. This is what true high-fidelity recording can do for the classical repertoire.

There is many a person who doesn't like Mozart, who would certainly be won to his cause by this superb re-production. In "The Prague," Mr. Kubelik has chosen to follow the broad melodic lines and polish and burnish the highlights of the whole by meticulous attention to tempi and dynamics. He is never overly fussy, neither is he sloven of detail. I think it fairly safe to say that his reading ranks with that of Sir Thomas Beecham and I've no doubt there will be many who will prefer it, sacrilegious as this may seem. The "34th in C" is an unjustly neglected work. A thoroughly delightful piece it fairly froths and bubbles with the effervescent reading afforded it by Mr. Kubelik. He recognizes the work for what it is; a light-hearted exposition on "much-ado about nothing." Again the work benefits from the superb fidelity of reproduction.

The AES curve reproduced the record perfectly with no necessity for tone control adjustment. Surface noise was almost non-existent. A wonderful farewell performance by Rafael Kubelik for Mercury. I trust we have not seen nor heard the last of Mr. Kubelik in this country.

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LAS PASTORELLA; SONATA FOR FLUTE, BASSOON AND HARPSI-LAS FASTONELLA; SUBATA FOR FLUTE, BASSOON AND HARPSI-CHORD IN A MINOR; CONCERTO FOR FLUTE, OBOE, AND BASSOON IN G MINOR; SONATA FOR OBOE AND HARPSICHORD IN C MINOR; CONCERTO FOR FOUR INSTRU-MENTS IN F MAJOR

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A collection of works by one of the greatest of Italian composers, Antonio Vivaldi. Now don't get up on your hind legs and run away! I know that the idea of anything like this strikes terror into you lovers of the hi and the fi. But hold on! There is some really good stuff here if you'll just take the trouble to listen. This admittedly is

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573	.45	6BQ7A	.92	12AT6	.35	12507	.55	45	.53	
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643	.87	6C4	.39	12AU6	.38	12V6GT	.50	SOCS	.41	
646	.49	6CB6	.45	12AU7	.55	19BG6G	1.15	SOLGGT	.59	
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trouble plus the section of the receiver in which it has probably happened. Next you get step by The looks of the picture on receis a had TV receiver can tell you at a glance what is wrong. PIX. O-FIX not only make this easy—but also show how and where to make the needed

PIX-O-FIX No. 1.—Identified 24 common troubles by actual TV screen photos. Gives 192 causes and 253 remedies for these troubles. Price separately, \$1.25.

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step repair instructions. the component likely to be faulty is specified. Quick tests to ap-ply to it are explained—or part substitution recommended where this is the best procedure.

The two PIX-O-FIX units cover 47 different kinds of TV trouble—just about anything you're ever likely to be called on to fix. Operation is simple and easy. Our money-back guarantee protects you fully.

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**MARCH, 1954** 



music for the more musically mature. but it is not all that formidable. The "La Pastorella" is a lovely work that sparkles like wine in the Italian sun. The quality of woodwind playing

found here is exemplary.

Each man is a virtuoso of his chosen instrument and it is evident from the good time they are having that they enjoy this spritely work of Vivaldi. The other works are combinations for the various woodwinds and are splendid examples of Vivaldi's amazing technical facility. Most are in sonata form and show clearly Vivaldi's penchant for contrast in his writing. He made daring innovations for his day, elevating the oboe from the obscurity of the orchestral whole to a solo instrument for which he wrote some exceedingly clever (and difficult) music. The reproduction throughout is very good indeed, the lone violin displaying no annoying edginess, and the woodwinds sibilant, snarly, sonorous as the score demands. A record to be treasured by students and others who appreciate this resurrection of some unjustly neglected Vivaldi. NARTB curve needed a few db of bass boost to reproduce satisfactorily and the surfaces were a little "ticky"

STRAVINSKY THE RAKE'S PROGRESS

Hilde Gueden, Blanche Thebom, Eugene Conley, Mack Harrell, Martha Lipton, Norman Scott, Paul Franke, Lawrence Davidson, soloists with Metropolitan Opera Association orchestra and chorus conducted by Igor Stravinsky, Columbia SL125, NARTB curve. Price \$11.90.

The advent of any work by Stravinsky is usually cause for much excitement and anticipation. When I heard reports some years back that he was working on a new opera, I made a particular point of watching for news of its completion and premiere. I was somewhat disappointed when the U.S. was bypassed in favor of Venice for the premiere which took place on Sept. 11, in 1951. I was further disappointed by the mixed reaction of the critics, and knew that I would never be satisfied as to its worth until I had heard it myself. By the time "The Rake's Progress" arrived at the Metropolitan, so much had been written pro and con about this opera, that tickets were a hard thing to come by and I never did get to see or hear the Met production. All this is by way of telling you of the happy appearance of this controversial opera on 2-12" Columbia LP's. Ah! The wonders of the age of LP! Not only is this the same Metropolitan production, but Stravinsky himself has been retained to conduct.

Has my wait been worthwhile? Decidedly yes! I can't agree with many of the European critics who rapped it for eclecticism, for lack of dramatic cohesion and goodness knows what else. I feel that if you analyze what Stravinsky had in mind here and what has been produced, you will come to the logical conclusion that this represents but a further extension of

a musical philosophy Stravinsky has been developing for some time now. Certainly it smacks of the Mozartian and Italianate. He has been integrating his amazing genius for polyphonic and polyrhythmic writing with 18th century elements ever since he wrote "Pulcinella." So the fact that he produces an opera essentially 18th century in character should come as no surprise to the musically literate.

I think what is really the basis of much criticism is a sort of wishful thinking, a desire for Stravinsky to return to his "wild" period, which produced "LeSacre du Printemps" and "Petrouchka." One cannot blame these people altogether, for I too would like to see Stravinsky produce at least one more work in this genre before he leaves this vale of tears. Well, come what may, I like this present effort and I think many of you will agree. The libretto by famed poet W. H. Auden and Chester Kallman is a moral fable with a pretty familiar story line, owing much to Hogarthian elements.

Space will not permit more than the briefest of story outlines: Boy and girl are in love. Boy wants money sells soul to devil. Carouses wantonly and degenerates morally, devil comes to claim boy's life, but loses out as girl proclaims her love and boy his, and he is saved. Boy goes mad and is committed to Bedlam. Mad love scene ensues between boy and girl and boy finally dies. (I suggest you read the jacket for a far more lucid description of the opera than I have just tendered you!)

The cast is an excellent one with special bows to Eugene Conley for his portraval of "The Rake" and Mack Harrell as "Nick Shadow" (the devil). Blanche Thebom is delightful as "Baba the Turk," but I was a little disappointed in the character of "Anne." 'The Rake's" love, as sung by Hilde Gueden. I felt that a more ingenuous quality was needed in keeping with

the story line.

The music is unusually scored since there are no trombone or tuba parts and this gives the trumpets the job of maintaining the bass line. The entire score reminds you more of a chamber concertante than anything else, but nevertheless is not wanting in power and expression when the need arises. The reproduction is top notch, for both vocal and orchestral elements. Strings are smooth and a fine orchestral balance is maintained by Stravinsky. Spaciously recorded but fortunately not so much so that the vocalists are obscured. The fact that the opera is sung in English adds to its attractiveness and the inclusion of a libretto makes for easy understanding. All in all, a major phonographic event and highly recommended. The NARTB curve needed no tone control alteration. The only thing I might quibble about is a good deal more of anticipatory tape echo than is usual. Somebody running too "hot" on the vu meter?

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These two records are further evidence that the Haydn Society is not above venturing into other musical fields than that which is the province of Papa Haydn. Which is a healthy trend, for ultra-specialization can be a dangerous drug which dulls the creative mind. These discs represent #1 and #6 of a series entitled, "Italian Classical Symphonists," Here the Haydn Society has done itself proud in bringing to light a whole group of 18th century Italian composers whose works are comparatively obscure. These are not in the category of what I call "desperation repertoire." In other words they have not been recorded merely because they were never previously recorded. There is a great deal of the trite and the banal being committed to LP these days, most of which is hardly worth wasting vinylite on even for musicological purposes.

Although one might gain the impression that there is too much recorded herein of similar line and invention. such is not the case. The music ranges from the rich contrapuntal textures of Albinoni to Geminiani's masterful transcriptions of his great teacher Corelli and his concerti grossi, to Sammartini and his symphony which was not really a symphony in conventional form as we know it, but which actually anticipated and fathered the sonata. All of these works are played expertly and with considerable elan by Newell Jenkins and the properly Italianate orchestra. Again, this is not fare for the hi-fi; by which I mean to say that there are no booming basses or tinkling triangles. But the fidelity of reproduction is nevertheless of the very top quality, with a warm, rich string tone and excellent acoustics. The NARTB curve was slightly bass deficient, but responded to a few db of boost. Surfaces were quiet.

THOMAS MIGNON

Genevieve Moizan, Janine Micheau, Libero De Luca soloists with chorus of Le Theatre Royal de la Monnaie, Brussels, L'Orchestre National de Belgique conducted by Georges Sebastian. L LLA15, ffrr curve. Price \$17.85. London

It looks like this must be the month for opera! I know there will be rejoicing with this new version of "Mignon." since it is the first complete recording

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on LP. Lovers of this comic opera have had to content themselves with excerpted highlights, not very satisfying to the opera addict. Of course the mere fact that a complete recording of "Mignon" exists does not gain for it immediate acceptance. Among the most canny buyers of records is the opera fan. He's from Missouri and wants to be shown! He can allay any fears he might have with regard to this version herein reviewed. It is a magnificent achievement from any standpoint. Genevieve Moizan as "Mignon" is absolutely splendid, Janine Micheau as "Philine" is her usual brilliant self, and Libero De Luca entirely convincing as "Wilhelm." There might have been a happier choice than Rene Bianco as "Lothario," but he is competent enough as are the other remaining soloists.

The ensemble work is among the finest I've ever heard in an opera. Georges Sebastian conducts, with authority, a better-than-average orchestra and in general keeps a firm but guiding hand on all the forces he commands. The sound is up to the high standards that London has set in its opera recordings. String tone is warm and vibrant, percussion very clean and accurate, soloists are projected with splendid clarity. "Big hall" acoustic perspective.

It is interesting to note the unique new method of packaging multi-disc sets that London has developed. Enclosed in the usual box-type album, between the inside cover and the record itself is a cube of foam rubber. This cube is somewhat larger than the space between album cover and disc. As a consequence, when the album is in a closed position, the cube compresses and holds the disc quite firmly in its inner shuck. This, of course, is of more practical importance in the shipping of an album to its distribution point. A clever little idea and one that seems to pay off, as there was a minimum of scratches and surface noise in the review copy sent to me. The ffrr curve reproduced the disc perfectly with controls flat.

#### MOUSSORGSKY

PICTURES AT AN EXHIBITION Philadelphia Orchestra conducted by Eugene Ormandy. Columbia ML4700, NARTB curve. Price \$5.95.

PICTURES AT AN EXHIBITION Chicago Symphony Orchestra conducted by Rafael Kubelik. Mercury MG50000, AES curve. Price \$5.95.

Many readers have asked for a comparative review on these discs, ever since the Ormandy version appeared. Whew! You guys don't mind putting me on the spot, do you? These are just about the toughest two discs in the LP catalogue to compare. Why? Well, let it be understood from the start that these two recordings are absolutely tops, each in its own way. As far as fidelity of reproduction is concerned. each is extremely wide range with no particular advantage of one over the other. The Mercury disc is now famous

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as the initial effort in their "Olympian Series," which also saw the inauguration of the single Telefunken mikeover-the-podium pickup. Columbia has made some constructional changes (what they are I haven't the vaguest idea) in the Academy of Music in Philadelphia. I presume these constructional changes were accompanied by new pickup techniques. So what is the essential difference between the two recordings, and which do I prefer? The Mercury, and for the following reasons. Tempo. This is a matter of performance you say. But, this is a peculiar circumstance in which the type of repertoire we are dealing with actually sounds different when played at various tempi. I thought Mr. Ormandy lost a great deal of the punch and the sonority of "Pictures" by conducting at a much faster pace than Kubelik. Acoustics and dynamic range; here is perhaps the crux of the whole matter. As I said, both recordings are recorded with equal fidelity. But the Mercury disc was recorded in the fortuitous acoustic environment of Orchestra Hall in Chicago. The combination of the repertoire and the acoustics made one of the most sonorous discs yet heard. The weight of the brass was tremendous and the percussion unbelievably solid. May I point out that this theory of repertoire and acoustics has been pretty well borne out by subsequent recordings made by Mercury in Orchestra Hall.

Take, for instance, Brahms "First Symphony" as recorded by the same orchestra and conductor, in the same hall. Yes, it is a very good recording. but no where near as sensational soundwise as the "Pictures." Many a hi-fi fan went to hear Kubelik play the Moussorgsky piece when the Chicago Symphony was at Carnegie Hall in N. Y. (contrary to popular belief, hi-fi fans do go to concerts). They heard the same splendid performance as on the disc, but most were disappointed in the sound. Of course! No two halls are alike as to acoustics and the acoustics of Orchestra Hall in Chicago just seem to go with "Pictures at an Exhibition," like ham with eggs.

You must remember that all the foregoing is just this reviewer's personal opinion. I have no doubt that there are many who prefer the Ormandy version. It is a splendid recording, but to me the more exciting result is the Chicago disc. The Columbia disc does have one advantage over the Mercury and that is the bonus of an excellent performance of Stravinsky's "Firebird Suite" on the flip side of the 12" disc. The Mercury version of "Pictures" occupies both sides of a 12" LP and those who have to watch their pennies a little closer than most may prefer the bonus value of the Columbia disc. Well, that's it. I am mentally cringing from the weight of wrathful letters I know will descend on my head for this review. But them's my views, Podner, an' I'm stickin' with 'em!

That is the "bag" of recordings for this month. Happy listening!



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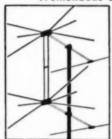
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#### Chromatic Color Tube

(Continued from page 53)

with the NTSC color TV system is shown in Fig. 3. The four video sections, containing the brightness and the three color signals, are required for the NTSC color system since the fine picture detail is transmitted on the brightness signal, and for color information each requires a separate amplifier. For the color signals, the amplifiers are relatively narrow-band stages, but for the brightness signal a 3.5 to 4 mc. bandwidth is desirable. Not shown in Fig. 3 is the synchronous detector which supplies the brightness and color signals. Also omitted are the vertical and horizontal deflection circuits.

The keying section is required to switch the output of each of the three color stages onto the single electron gun. In the RCA tri-color picture tube this is not necessary since each color channel is connected to one of the three electron guns. The tri-color tube is essentially a simultaneous device, while the "Chromatron" breaks the simultaneous NTSC system into a dot-sequential picture.

The operation of the color grids and their associated circuits is shown in some detail in Fig. 3. In order to maintain the d.c. focus potential between the two color grids and the aluminized phosphor backing, a center-tapped coil is required to make this potential equal at both grids. In Fig. 3, it is assumed that the secondary of the output transformer is resonated with the color grid capacity and properly matched to the primary for maximum transfer.

The driver stage can be a power amplifier driven by a voltage amplifier which, in turn, is driven by the color synchronizing oscillator. This 3.58 mc a oscillator is controlled by means of a keyed a.f.c. system from the color synchronizing burst transmitted after each horizontal synchronizing pulse in the

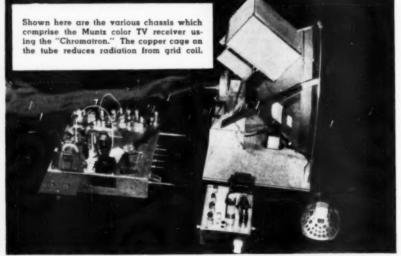
composite color signal. In order to obtain true color rendition it is absolutely essential that the frequency remain constant and no phase shift or distortion be introduced.

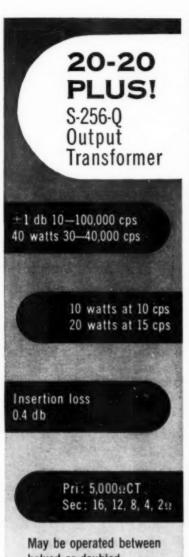
The high voltage section of the "Chromatron" is somewhat different than for the RCA tri-color picture tube. Good regulation of the anode voltage is not required for the "Chromatron" whereas it is for the tri-color tube.

At the time of writing, several demonstrations of the "Chromatron" have been given. When demonstrated with the NTSC color TV system the "Chromatron" itself appears fairly good. The pictures on one of the tubes appeared to have considerable red streaking which apparently was due to the red phosphor's long persistence. This feature can be remedied by using a different red phosphor. At a viewing distance of about 10 feet, the individual lines are not visible and the viewer sees only the complete color picture.

One interesting aspect of the line structure is the fact that the lines and the grid wires behind them can be oriented either vertically or horizontally and both types of tubes have been tested. It was found that when the colored phosphor lines are in the same direction as the horizontal scanning lines the color moire pattern is much less visible at closer viewing distances. The actual width of the color phosphor lines has not been definitely set, but tubes with strips as narrow as 0.010 inch (10 mils) have been built. When these strips are applied horizontally, the resulting line structure is fine enough to enable the viewer at ordinary distances to see the complete color picture exclusively.

Chromatic Television Laboratories and some other tube manufacturers are developing improved tubes. Some of the planned improvements include much narrower phosphor strips, permitting a greater number of strips and therefore better resolution. Color grids will be made of finer wire and a better





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set of colored phosphors is under consideration. The problem of the persistence of the phosphors can be solved when a color combination is found which produces the correct primary colors and has equal brightness and persistence under the same accelerating potential. In the sample tubes demonstrated so far, the correct phosphor combination was lacking, but some fairly good pictures were observed with a compromise arrangement of phosphors.

#### Basic Color TV

(Continued from page 70)

done on how much color the average human eye really sees. This work, in conjunction with other data which has appeared from time to time, brought forth several very interesting facts.

1. The theory that vision is a threecolor process is true only when the object viewed is relatively large. On a television screen, this refers to objects which are produced by video frequencies from 0 to .5 mc.

2 For medium-sized objects, say those produced by .5 mc. to 1.5 mc. video frequencies on a television screen, only two primary colors are needed. Blues and yellows are among the first colors to lose their color and become indistinguishable from gray within this range.

3. For very fine detail, say those reproduced by video frequencies from 1.5 to 4.0 mc., all people with normal vision are color blind. In other words, all that is seen are shades of bright-

The conclusion to be drawn from the foregoing is that 4 mc. color is not necessary. All we require is color up to 1.5 mc. And even within this range, we need all three colors only to .5 mc. and only two primaries for the color signal extending from .5 mc. to 1.5 mc. In the formation of the NTSC signal, these facts were put to use by employing one color signal, called the "Q" signal, with a range from 0 to .5 mc. and a second color signal, called the "I" signal, with a bandpass from 0 to 1.5 mc. The rest of the video picture, containing all of the fine detail, is reproduced in black-and-white by a monochrome signal and the eye is none the wiser. As a matter of fact, a full color television signal consists of a 0 to 4 mc. monochrome video signal (just as we have in black-and-white broadcasting) plus a color subcarrier containing the "I" and "Q" color signals men-tioned previously. It has been truly said that the NTSC system is a "colored" television system.

The monochrome signal possesses such alternate names as brightness signal and luminance signal. The color portion is frequently referred to as the chrominance signal.

In the next article of this series we will see how the NTSC color signal is formed and of what it consists.

(To be continued)



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# SERVICE HINTS ON STEWART-WARNER TV SETS

Poor horizontal linearity.

If it is sometimes difficult to obtain the correct horizontal linearity through adjustment of the horizontal linearity, horizontal drive, and width controls, change condenser 280, in the return lead of the horizontal output transformer (red lead from terminal 6 to deflection yoke), from .1 µfd. to .25 µfd.

Critical horizontal hold.

This condition may be due to an increase in the value of resistor 258, which should be 3900 ohms, in the plate circuit (pin 2) of Vin 6SN7GT horizontal multivibrator. Check this resistor and if its ohmic value has increased above 10%, replace it with another 1/2-watt, 10% tolerance unit.

Also check resistor 263, in the other plate (pin 5) circuit of this tube. The value of this resistor should be 270,000

Picture centering trouble.

If it is impossible to center the picture without producing neck shadow, apply the following circuit modifications:

- 1. Disconnect the yellow lead of the focus coil socket from the 340-volt "B+" supply, and reconnect it to the red lead coming from pin 7 of the deflection voke socket
- Disconnect resistor 363 (12,000 ohm, 2 watt) in the screen circuit (pin 8) of the horizontal output tube (6CD6G) from the 340-volt "B+" supply, and reconnect it to the red lead coming from pin 7 of the deflection yoke.

#### 9200 SERIES

Poor vertical hold.

In weak signal areas, or in areas with a great deal of external electrical interference, do the following to improve the vertical sync stability:

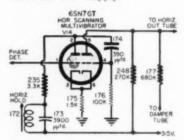
- 1. Change resistor 160, in the plate circuit (pin 6) of the 12AU7 phase splitter  $(V_{iii})$ , from 3300 ohms to 6800 ohms.
- 2. Change resistor 219 tirom pin 6 of the 12AU7 phase splitter to terminal 1 of the vertical integrator network), from 56,000 ohms to 27,000 ohms.

Saucal.

During the receiver warm-up period, a high-pitched squeal may be emitted. This comes from the horizontal multivibrator, and can be eliminated by doing the following:

Change condenser 174, in the plate circuit (from pin 2 to pin 4) of the 6SN7GT horizontal multivibrator  $(V_{ii})$ , from 470  $\mu\mu$ fd. to 390  $\mu\mu$ fd.

- 2. Change resistor 177 (connected to pin 5 of  $V_{10}$ ), from 330,000 ohms to 680,000 ohms.
- Change resistor 235 (connected to pin 2 of V<sub>n</sub>), from 3900 ohms to 3300 ohms
- 4. Add a 270,000-ohm, 10%, 12-watt resistor from pin 5 of  $V_{ii}$  to the 315-volt "B+" supply.



See accompanying diagram for new circuit.

Vertical bending.

In moderate or strong signal areas, vertical bending may be encountered. To overcome this action, insert a 27,-000-ohm isolating resistor in the plate circuit of the 12AU7 phase splitter. This resistor should be inserted between the plate (pin 6) of the 12AU7 and lead 1 of the vertical integrator printed circuit.

Picture centering trouble.

If it is impossible to center the picture without producing neck shadow, disconnect the yellow lead of the focus coil socket from the 315-volt "B+supply, and reconnect it to the red lead coming from pin 7 of the deflection voke.

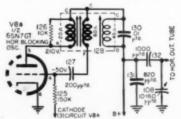
#### 9300 SERIES

Poor horizontal hold

If the horizontal hold action is critical, follow the procedure outlined be-

1. Check to see that condenser 131 is a siver mica 820-μμfd. unit with ± 5% tolerance.

(See accompanying diagram.)



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2. Check to see that condenser 130 is other than a Sangamo type (red This .01-µfd. condenser should be the type supplied under the Stewart-Warner Part No. 512311. Do not use a substitute.

3. If the receiver has a "horizontal range" trimmer condenser, it should be screwed closed.

If a 6SN7GTA tube is used as the horizontal a.f.c. locking oscillator (V.), replace it with a 6SN7GT.

Turn the receiver on and allow it to operate for fifteen minutes.

Set the horizontal hold control, on the front of the receiver, to its counter-clockwise position.

Remove the 6BE6 gated sync separator tube from its socket. This will cause the receiver to lose both horizontal and vertical sync.

If it was necessary to replace condenser 130, the receiver will probably be far off of horizontal frequency. This should be corrected by adjusting the bottom slug of the syncro-guide transformer (Part 128) until the picture "hunts" horizontally. The picture will remain intact and slide from side to side across the screen. If condenser 130 was not replaced, do not adjust the bottom slug of transformer 128, but do adjust the top slug for "hunting."

Plug the 6BE6 tube back into its socket, and set the front control of the receiver to the center of its

range.

#### 21-INCH RECEIVERS

Dark spot on CRT.

A round dark spot, approximately 4 inches in diameter, may appear in the center of the picture tube on some of these receivers. This spot is due to the fact that the picture tube is too close to the safety glass. An electrostatic discharge to the glass reduces the high voltage on the picture tube in a small area, and the dark spot results.

To remedy this, loosen the chassismounting bolts, and slide the chassis back as far as it will go.

Howard W. Sams (center) president of the firm bearing his name, accepts the "Friend of Service Management" plaque of the National Alliance of Television-Electronic Service Associations on behalf of his company. Frank J. Moch of Chicago, president of NATESA (right) looks on as Mr. Sams shows the plaque to Fred Colton, NATESA's eastern central vice-president and chairman of the board of the Associated Radio & TV Service Dealers of Columbus. More than 100 civic leaders and electronics executives attended the recent ceremonies.





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# RADIO-TV Service Industry News

### AS REPORTED BY THE TELEVISION TECHNICIANS LECTURE BUREAU

N RESPONSE to the many inquiries that have been sent to the Bureau, a survey is now being completed that will provide the required information for a chart of standard labor charges for radio and phonograph service. Readers who would like to be notified when these charts are available should send a stamped, addressed envelope to TTLB Information Service, P. O. Box 1321, Indianapolis 6, Indiana, and request information on the Standard Radio Service Labor Charges Chart (RSL-1).

Color TV Service Charges

It will probably be a long time before the independent service industry will be called upon to install and service color television receivers. The set manufacturers will go into the production of color sets very cautiously. Field experience must be acquired both on the stability of circuitry under a great variety of operating conditions and the range of the likes and dislikes of the general public on color variation and deviation.

The early sets will be prototype models that will be closely watched in service by factory field service engineers and distributor service personnel. Even if color picture tube production should build up faster than is currently anticipated, production runs of color sets, which will carry high list prices, will be very limited.

The industry generally anticipates that color receivers will require far more service attention than monochrome receivers even after circuits and components have been perfected to the point where large-scale production is possible.

Quite naturally, charges for contract and C.O.D. service on color receivers will be determined through experience when thousands of sets are in use. But as a starting point, all sets that will be sold in the early days will probably have a mandatory 90-day parts and service warranty which the purchaser must buy and some may even require the purchase of a 1-year parts and service warranty. How much will set purchasers have to pay for these parts and warranty agreements?

Those best qualified to judge the

service requirements of color sets during the early stages, say that the average 90-day parts and service warranty will cost the purchaser about ninety dollars and the 1-year service contract and parts warranty will cost him about \$295.00. These estimates do not include the installation of an antenna.

Adequate Service Charges

It should be obvious to every service shop operator who handles TV service that he must assume part of the responsibility for educating the set-owning public to pay adequate charges for TV service. Those who still live under the illusion that they can continue to advertise home service calls for \$2.50 or \$3.00 and make up the difference in loaded tube and parts bills will find more and more realistic operators urging set owners to demand the old tubes and parts removed from their sets. As service customers become wise to the padded parts and tube gimmick, men who have promoted their businesses on the basis of small charges for home service will find themselves squeezed into an impossible position.

All of the factors involved inadequate pricing of service labor are now so well known that there is no reason why anyone should offer to perform TV service at a lower price than it can be given—honestly—and return to the business the sort of income a competent technical business has a right to

The bulk of the income of a service business must come from the sale of labor. Records show that where adequate labor charges are levied for service, and the parts and tubes charged for are held to those really required to service the sets, 80% of the service income comes from labor charges and only 20% from the sale of replacement parts and tubes. In other words, each ten dollars of service income includes \$8.00 for a service technician's time and \$2.00 for the parts used in repairing the sets.

How much is experienced technical labor worth? If you are a top-flight technician operating your own service business how much "take home pay" should you expect to get from your

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business to warrant the application of your time, energies, training, and experience plus all of the risks involved in running a business of your own?

Last November, the RCA Service Company completed a new contract with its employees' union which provided for the following wage schedule:

per week hours Chief Technician.....\$115.00 40

Journeyman Installation & Service Technician... 95.00 40 Apprentice Installation &

Service Technician.... 50.00 40

The schedule for apprentices provides for regular increases in the wages paid apprentice technicians every six months until, after 42 months of satisfactory performance and progress, they will receive the journeyman's scale of \$95.00 per week.

How good a TV service technician do you consider yourself to be? Do you demand of your business that it pay you \$115.00 per week for yourself and family and a return on your investment in equipment, tools, and supplies? If you are running a one-man TV service business and want that business to pay you \$115.00 per week for working eight hours per day for five days a week, you will have to get \$8.56 net income from each service call you make, and you must average 7 calls regularly every day.

Although most one-man TV service operators work six days per week and ten or more hours per day, few of them are able to consistently average 35 service calls per week. The determining factor is not the number of hours per day or days per week a man works, but what he is able to accomplish in completed service jobs during the time he is available to work.

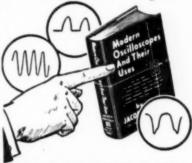
A great many studies have been made to determine the minimum size. in personnel, a service organization must be to operate profitably, and the optimum size for most efficient and profitable operation. The conclusion reached is that for most cases, a threeman operation is a minimum organization. Generally, where less than three men are employed, the time lost in handling non-income producing details of the business make it impossible for the one- or two-man shops to handle enough income-producing business to pay incomes commensurate with the technical skills of the men who operate the business. That this conclusion is sound is evidenced by the very high mortality rate among oneand two-man shops.

What will color TV demand in organization size for efficient and profitable operation? The following predictions by Paul V. Forte in a recent issue of the "Almo Broadcaster," published by the Almo Radio Company of Philadelphia, may prove significant:

"Take the green out of your eye, the red from your face, and don't be blue. The new year will be a colorful one, and particularly in the television industry.

"From its inception, television has been a turbulent business and nine-

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teen-fifty-four will have more than its share of turbulence. This is inherent in growth and the business will grow faster than it ever did before, despite some rumors to the contrary. More important, the growth will bring about healthy changes that will hurt some but bring great benefits to the majority.

"Color is to be feared only by the ignorant, no matter what phase of the television business he handles. Our immediate interest, however, lies in its effect on the television service busi-We would like to discuss this ness. effect in the form of predictions for the year, a pleasant practice in which we all indulge around the first of the year.

"We predict:

"1. This year will be the beginning of the end for the greatest majority of the individual TV servicemen, particularly those who operate from home or after hours of normal business. intricacy of color television will require more facilities, resources, equipment, and organization in its service than an individual can provide.

"2. There will be many mergers of service businesses as individuals and small groups realize the necessity and desirability of pooling resources. Efficiency and economy of operation will be demanded by the consumer when he begins to realize the cost of both color and u.h.f. service. As you know, u.h.f. is scheduled to be with us in Philadelphia soon and the lack of consumer education on this score will be seriously felt by service people.

"3. The shortage of really competent service technicians will become even more painfully apparent in the coming year. The larger service organizations will take unusual steps to hold those they have and develop the potential in others where and when they must.

"4. Service trade organizations will become bigger and more influential as service technicians and business operators begin to realize, fully, a proper concept of their functions. That these associations can and will do a job that the individual service operator can't begin to do in his relations with the consumer and the industry will become too obvious to be passed over lightly, as in the past.

"5. Manufacturers and distributors will give more and more attention to the needs of the service industry than they have in the past. They will do this for a very good reason: because it is good business. They are beginning to realize the value of the goodwill of service people, especially as it begins to reflect on balance sheets in the sale of receivers, parts, tubes, and related equipment.

"Mark these predictions! Some of them began to take form months ago but they are still almost shapeless masses. Color television will be the catalytic agent that will make them stand out sharply."

Service in 1954

At the turn of the year, the industry generally was jittery over the possible



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#### PHYSICS GRADUATE

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#### RADAR

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HUGHES RESEARCH AND DEVELOPMENT LABORA-TORIES ARE ENGAGED IN A CONTINUING PROGRAM FOR DESIGN AND MANU-FACTURE OF ADVANCED RADAR AND FIRE CONTROL SYSTEMS IN MILITARY ALL-WEATHER FIGHTERS AND INTERCEPTORS.

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THE GREATEST advancements in electronics are being made in this sphere because of military emphasis. Men now under 35 years of age will find this activity can fit them for future application of highly advanced electronic equipment.

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RESEARCH AND DEVELOPMENT LABORATORIES

SCIENTIFIC AND ENGINEERING STAFF

Culver City, Lon Angeles County, Calif.

Assurance is required that relocation of the applicant will not cause disruption of an urgent military project. effect of color television on the sale of black-and-white sets. The industry had produced TV receivers throughout 1953 at the annual rate of about 7 million sets and there were some fears that a drastic cutback would take place when the public started to sit on its purse strings and wait until they could buy color sets. Forecasts by industry authorities, though, were very optimistic for business this year. Typical of these forecasts that are of special interest to the independent service industry are the following made by G-E's Dr. W. R. G. Baker:

"I believe the industry can look forward to these developments in 1954:

"1. A strong demand for monochrome television station equipment and receivers with the addition of about 200 new TV stations during the year, bringing the total to 550 in operation by the end of 1954.

2. Introduction of limited color telecasting opening a new market area for broadcast equipment and receivers.

"3. Industry to distributor sales of 5,200,000 monochrome and 100,000 color TV receivers, and continued strong demand for radio receivers with industry production of about 7,600,000 home and portable radios.

"4. Further improvement in monochrome TV picture tubes, intensified research and development in tubes for color TV, and continued growth in total tube sales by the industry.

While industry attention will be focused on color television, service technicians will be offered many training programs to apprise them of the technical aspects of compatible color TV and the installation and servicing requirements for color TV sets. However, color television will not add any appreciable volume of business to the activity of independent servicing during the coming year. As a matter of fact, it may be two years before the service industry has an opportunity to service any considerable quantity of color TV receivers.

Industry thinking about the effect of color TV on the production and sales of other home entertainment electronic devices was more or less summed up in the year-end report of Robert W. Sprague, chairman of the Board of Directors of RETMA:

"With good merchandising, I believe the industry should be able to sell at least 6 million television sets and 10 million or more radios in 1954 unless incomes generally drop more sharply than now seems likely. Most manufacturers feel that black-and-white TV sets will continue to constitute the bulk of the set sales for years to come. All agree that relatively few color receivers will be available in 1954, and that these, of necessity, will be very high priced and will have screens that are small in comparison with the larger screen black-and-white sets available at a third the price or less.

"Certainly, color TV programs will be distinctly in the minority for a long while despite understandable ballyhoo that will attend color broadcasts in



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478 - CAPACITY BECADE BOX - Nit \$18.95 . Wired \$24.95 912 - RF PROBE - Wired and Calib. \$4.25

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Philadelphia, Pa. 6th & ORANGE STS. \* Wilmington, Del 4401 VENTNOR AVE. \* Atlantic City, N. J 1133 HADDON AVE Camden, N. J 219 Highland Ave Solisbury Md 1954. Sponsors will be slow to spend money for color programs which so few persons will be able to see, except in black-and-white.

In the meantime, there is a whale of a lot of service work to be done on radios, phonographs, and other electronic devices that are widely used in homes and businesses. In many areas, service operators who have been making a fringe living competing for TV service business have ignored the tremendous need for service on radio sets, phonographs, and wire and tape recorders

In one city recently checked by your editors, a dealer in office equipment had found it necessary to hire a technician to repair wire and tape recorders in order to protect his market for these devices which he was selling for use as dictating machines. Within six months the service end of his business had grown so much that he had to add a second technician. The increased service business came from owners of recorders who learned about his recorder service facilities. Within eighteen months the profit from his recorder service department exceeded the profit he was making from the sale of new

During this same period in this same city several dozen service operators were knocking themselves out competing for TV service business at \$2.50 per call, slowly starving themselves out of business blind to the immense pool of profitable service business that was available in radio, phonograph. and recorder repairs.

There are two ways to merchandise service. One is to wait for service business to come to you, the other is to go out after business. The first way is the negative way. It lets your business wobble up and down at the whim of customers who call on you as a last resort and then want good service fast and chean

The second way going out after business-is a positive way. When you merchandise your business that way it puts you in command of it. You are in a business that is unusual in this respect-you have a 100% market for your services. There is hardly a home in your market area right now that doesn't need the services you have to sell on some piece of electronic equipment now in use or shelved for service. It may be a TV set, a radio set, or a phonograph.

How do you go out after business? It's simple in a business like yours with a 100% market so clearly defined. Use a simple, inexpensive, direct-mail program. Ask your parts jobber about the direct-mail programs the tube manufacturers have prepared for you. They are good, effective, and inexpen-

#### Technician Associations

(Continued from page 85)

#### UTAH

Utah Ass'n. of Radio & Television Servicemen, 418 Frick Bldg., 23 E. 1st S., Salt Lake City 1-John F. Burns, Pres.: Robert J. Magness, Sec'y-Treas.

#### WASHINGTON

The Northwest Appliance & Television Ass'n., 714 American Bldg., Seattle 4-Keith Davis, Pres.; L. Edward Smith. Exec.

Victoria & Island Chapter of the Radio Electronic Technicians Ass'n., 783 Fort St., Victoria, B.C.—Dave Banfield, Pres.; George D. Percy, Sec'y.

Radio Electronic Technicians Ass'n., P.O. Box 391, Winnipeg, Manitoba-N. Weibe, Pres.; V. Sexton, Sec'y.

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Base in a smooth, uniform coating. Highest performance for thousands of playings. Red Oxide Base in a smooth, uniform coating: greater signal strength; with maximum fidelity: uniform frequency response from 40-15,000 cps at 7½" per second; and freedom from background noise and distortion. Each reel is individually boxed.

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PLAINFIELD, N.J. 139 W. 2nd St. NEWARK 2, N.J. 24 Central Ave.

#### Spot Radio News

(Continued from page 18)

relax its present rules. Specifically, the present minimum of 42 hours of operation would be reduced to 36, and secondary or subsidiary licenses would be offered to those engaged in nonbroadcast services which involve special programming on a simplex basis during non-broadcast hours using an ultrasonic (beep) signal to activate special receivers owned or rented by commercial and industrial establishments for the purpose. Secondary licenses would also be available for additional program transmission on a multiplex basis during regular broadcast hours to individuals and organizations who have the necessary multiplexing receivers. These possibilities. it was said, embrace functional music (background, storecasting, and transitcasing), and such appropriate supplemental programming as news, music, time and weather announcements. which would further utilize the FM frequencies, and provide sources of additional income for FM broadcasters. They would not, however, cover such activities as dispatching services, etc. Nor could the FM licensee lease or otherwise delegate such special author-

The decision to ease the rules represents quite a turnabout, for only a few years ago it was pointed out that beep operations were inconsistent with basic statutes of the broadcast law, and that technically the licensees had given away the power to alter their service to meet the changing needs of the public because they had entered into contracts to provide subscribers with planned music. The Commission also cited that the elimination of sponsorship, station identification, and other announcements from reception by subscribers, although made to the general public, violated the law, since the requirements of the Act contemplate transmission of such information to the station's entire audience and not to the broadcasting of a tone which prevents a portion of the audience from hearing the announcements.

The change in heart was prompted by a reconsideration of the legality of such broadcasts and the serious economic groove in which the FM broadcasters find themselves. Of the 53 independent FM stations reporting in '52, only six showed a profit; five had net incomes before Federal income taxes of \$2000 or less, the highest income being \$4600. The Commission also noted that 87% of the 616 FM stations on the air were operated by AM licensees, the large majority of which provided the FM service as a bonus.

On the basis of their review of the FM picture, the Commission added, they believed that it might be possible to provide for a more effective use of the frequency space now assigned for FM, making possible the rendering of new and useful services, and enabling

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Now for the first time at the low, low price a 3 speed VM. Changer complete price a 3 speed VM. Changer complete with 3 tube high quality amplifier. This unit uses the newest type VM. Changer intermediate the substitution of the complete speed of the complete spee



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MAGCH. 1954

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The "Edu-Kit" effers you a Home Radio Technician
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solder in a professional manner. You will learn how to
operate Receivers, Transmitters, and Audio Amplifors.
You will learn how to service and frouble-shoet radios.
You will learn how to service and frouble-shoet radios.
F.C.C. license. In brief, you will receive a basic education in Radio exactly like the kind you would expect to receive in a Radio Course costing several hundred dellars.

THE KIT FOR EVERYONE
It is not necessary that you have even the slightest
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i	NAME
i	ADDRESS

PROGRESSIVE "EDU-KITS" INC. 497 Union Ave., Dept. RN-28, Brooklyn 11, N.Y. FM broadcasters to alleviate, in part, their financial difficulties.

Commissioner Frieda Hennock did not agree with her fellow Commissioners that the new proposal was a logical one. And in a biting dissent, she said that the new plan, in her opinion, amounts to a reallocation of the FM band, and ". . . no amount of emphasis that . . . the aim . . . is not conversion of the band to some new specialized non-broadcast service . . . will change this result."

Continuing her blast, Madam Commissioner added: "If the spectrum space allocated to FM broadcasting is excessive, or not fully utilized by that service and capable of accommodating the services, all persons interested in radio communications should be given an opportunity to apply for the use of these frequencies. As it is, only FM licensees would be the beneficiaries of this proposal, for only they would be eligible for the proposed SCA (Subsidiary Communications Authorization) to engage in non-broadcast operations. In my opinion, it has not been shown that it would be in the public interest so to restrict the scope of what essentially is a proposal for a new allocation of 20 megacycles of spectrum space."

The proposal to convert the FM band to private non-broadcast use may give FM licensees a windfall from the public domain, the fiery Commissioner added. She viewed the use to which the FM band can be placed through multiplexing as virtually unlimited. "While the Commission emphasizes that the primary use of the band is to remain FM broadcasting," added Commissioner Hennock, "by the very nature of the manifold uses, such as multiplexing, functional music, storecasting, transitcasting, and all other services lying between functional music operation and taxicab dispatching service, FM broadcasting may well be relegated to a subsidiary position. This is certainly a case of the tail wagging the dog.'

PREDICTIONS citing the number of stations that would be on the air, offered early in '53, were shattered and splattered as the year came to a close. For instead of the mere 75 stations that it was said would perhaps begin telecasting during '53, the records showed that 225 had joined the television-broadcasting bandwagon, bringing the total number of on-the-air stations to nearly 360. (As this column was being prepared stations appearing in the table below received permits.)

And if somewhat the same processing pace is maintained in '54, at least 200 to 250 more stations are expected to come on the air during the new

The records also show that about two-thirds of the new stations were ultra-high operated.

A possibility that station spacing may be altered, permitting more channels to some cities, was set aside by the Commission, who felt that it would not be wise at present to revise any assignment principles. Requests for such changes came from those who

### **GRANTS SINCE FREEZE**

Continuing the listing of construction permits granted by FCC since lifting of freeze. Additional stations will be carried next month.

STATE	CITY	CALL	CHANNEL	FREQUENCY	POWER*
California	Palm Springs San Diego	KPAL†	14 21	470-476 512-518	13.275 186
D.C.	Washington		50	686-692	95.2
Florida	Clearwater Miami Miami	WMIE-TV WINZ	32 27 33	578-584 548-554 584-590	93.5 200 182
Georgia	Thomasville		6	82-88	6.03
Illinois	Chicago	WOPA-TV	44	650-656	205
Kentucky	Lexington	WLAP	27	548-554	247
Maryland	Baltimore	WSID	18	494-500	85.2
Michigan	Traverse City	WPBN-TV	7	124-180	51.3
Missouri	Joplin Kirksville	KSWM† KBIZ†	12	204-210 60-66	58.9 100
Minnesota	Duluth	KDAL-TV	3	60-66	100
New York	Bloomingdale (Lake Placid)		5	76-82	3.55
	Carthage		7	174-180	190
North Carolina	Asheville	WLOS	13	210-216	170
Ohio	Cleveland		19	500-506	220.3
Oklahoma	Ada Enid	KEOK	10	192-198 76-82	251 100
South Carolina	Spartanburg	WORD-TV	7	174-180	316
Tennessee	Jackson	WDXI-TV	9	186-192	56.2
Texas	Amarillo Corpus Christi San Antonio	KLYN-TV	7 43 12	174-180 644-650 204-210	5 37.1 316
Utah	Provo	KOVO	- 11	198-204	64.6
Virginia	Richmond	WTOB-TV+	29	560-566	17
Washington	Seattle		20	506-512	200
Wisconsin	La Crosse	WKBT	38	614-620	18.2

\*ERP = (effective radiated power, kw.). .. = Call letters to †=Temporary call letters. be announced

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TG-10 KEYER—same as above—

#### TG-34-A KEYERS

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PROP PITCH MOTOR 24 to 33 VAC or DC 14 ampi-Reversible, only 3 weres required 7000 to 1 good reduction. Stops free swim; approx. 3a RPM 44 H. P. Motor-Rugged gear train and sturdy thrus-tearings—wt. 6.3 lbs.

TRANSTAT VOLTAGE REGULATOR-Type RH-115 VAC 400 cy.-.72 KVA-output 75 to 120 V ii 6 Anno-black wrinkle finish metal case-wt. 11



#### RT-48 TPX-1 TRANSCEIVER EXPERIMENTERS IDEAL FOR UHF 157 TO 187 MC

Contains Video Ampl. aweep cir-cuits. 17 tubes, plugs and many misc. parts—in case with

lid. wt. 47 lbs. Priced only at a fraction \$1 495 of original cost.

TYPE T-3074 UHF TRANSMITTER 180-220 MC-British made with pr. of funed lines and 2 VT but British tubes. See Feb. Adv. for Cut 4 Details. New

SATTERY CHARGES METER-0-10 de amp-Ne NS-23 HEADSET-hi-impedance-practically new \$2.95 N-16 U HEADSET\_BOOD ohms 82.95 CD-608 CORD-with PL-55 plug-615 cord

ASSORTMENT OF HOME- AUTO-ROVE KNOBS-FTR HALF-WAVE RECTIFIER Toput: 72 VAC. Out.

felt the mileage-spacing ruling should be modified to include a five-mile tolerance instead of the fifteen-mile limitation now on the books; rule now makes a channel available for an unlisted community within 15 miles of the listed

A NEW ERA in TV and radio reporting from Washington was ushered in shortly after the new year, when after more than sixteen years of waiting, a huge remodeled room with sparkling new studios on the gallery floor of the Senate wing on the U.S. Capitol was opened.

Now, instead of being shuttled about and crowded in a nook, radio and TV networks, four major film services, and 35 individual radio stations and special news services can use a new TV studio which is 20 by 1514 feet, or either of four radio rooms.

The refurbished gallery, technically known as G-25, is next door to the press gallery. Many interviews with Congressmen will be forthcoming hereafter from these new studios. Some might be live, some filmed, and some taped. To the broadcasters who initiated the move and to the 83rd Congress who appropriated the money (\$33,000), everyone is grateful for this change; a glowing tribute to the maturity and dominance on the American scene radio and TV has achieved. . . L.W.

#### **EDISON HAM AWARD**

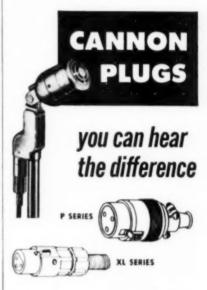
STAN SURBER of Peru, Indiana has been named the outstanding ham of 1953 and awarded the "Edison Amateur Radio Award" by General Electric Co., sponsor of award.

W9NZZ was named for his service as "mailman" for servicemen stationed at Arctic weather stations, Surber was nominated in 112 letters from 28 states and 5 foreign countries.

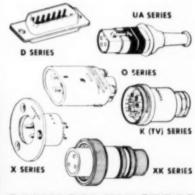
A wife can watch a variety show while her husband enjoys a different program at the same time on the same screen on the new Du Mont "Duoscopic" television re ceiver. Viewing is done through polaroid glasses or polaroid panels. By reversing the glasses or panels, the viewer can choose the alternate of the two programs tuned in. Individual earphones are used to sepgrate the sound portions of the programs. A remote control unit permits the viewer to listen to either of the two programs.



### for **every** audio need



In addition to the lines illustrated, the 45E Test Point Jacks and connectors in the GB, U, and M1-4 series are available through the 130 selected franchised distributors for Cannon Electric. Other electronic-electric distributors also sell certain items in the Cannon line, including XL, M1-4, and GB series connectors, and a variety of Cannon Specialty Lights. Write for the RJC and Audio Connector Bulletins.



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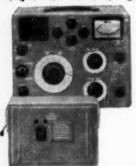
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#### Marconi SPECTRUM ANALYZER IF 890-1

Frequency: 9000 - 9650 mcs
Attenuation: 0-27 db. calibrated
Power:110-120-220-240V 40-100 cps
A precision laboratory or portable instrument
which may be used as a SPECTRUM ANALYZER, SIGNAL GENERATOR, WAVE
METER, POWER METER, FREQUENCY
METER, for measuring pulse width, cw
spectrum width, or any X bend test within
this frequency. Set is supplied with power
supply and complete hit of adapters, wave
guide, attenuator and all accessories



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#### How's Your Rumble?

(Continued from page 79)

ment. Column A shows the results on one hi-fi set-up using a record changer, a wide range amplifier and a corner horn speaker. The rumble on this system was definitely noticeable at moderate volume levels and very objectionable at high levels. The greatest increase in noise occurs from the vibration of the phono motor. Nothing was found wrong with this motor and when a new unit of the same type was substituted a change in vibration noise of only 1 db was noticed. Thus the rumble in this system was pretty much due to the vibration inherent in this particular type of motor. Column B shows the performance of this same system when an improved type turntable was substituted. The rumble dropped to a level which was just detectable at high-volume listening.

Column C shows the results of these tests on another system. This set-up uses a record changer, a wide range amplifier, and a large bass reflex cabinet. It is obvious from the data that hum or noise from the preamplifier is a problem. The large increase in noise when the turntable is rotated is an indication of a rough turntable rim or idler wheel. The rhythm of the turntable noise coincided with the revolutions of the idler wheel rather than the turntable. Replacement of a noisy tube in the preamplifier and a thorough cleaning of the record changer plus installation of a new idler drive wheel produced the results of column D. The rumble level was considerably improved and satisfactory.

Now it should be made clear that we have not really measured the noise level from each of the components by this method. We have simply seen how noise accumulates as it proceeds through the equipment and this is helpful in telling where the abnormal conditions lie. With a little experience in this method it is easy to size up the noise and rumble problem in a high-fidelity system.

#### General Considerations

In analyzing a rumble problem the first step is to have it demonstrated to you under actual listening conditions. A few checks of the control settings plus some discussion will enable you to tell if (1) the listener is very critical, (2) if he likes music very loud, (3) or if he likes tremendous bass boost. Each of these three points lowers the amount of rumble which can be tolerated. You can also tell from your knowledge of equipment how low the bass response of the speaker goes. Careful listening will tell if the speaker has a peaked bass response or an over-resonant boom. If either of these troubles is present it would simplify the rumble problem and improve the over-all sound to correct them first.

The main question to be answered

#### RCA MI-2475 SOUND POWERED PHONES

NEW EXPORT PACKED Shipping weight 5 lbs.

complete with 22' rubber covered cable press to talk switch are light weight, the mic is on a swivel boom that can be moved to any position in front of face. Cost \$62 ca.

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Just book up the old make and model you want to fix. This manual-size, 3½ pound, 744-page Ghirardi handbook tells what the trouble is likely to be . . . and shows you exactly how to fix it. No useless testing! No wasted time! Even beginners can handle

### THE ONLY GUIDE OF ITS KIND! Cuts service time in half!

Included are common trouble symptoms and their remedics for over 4,800 models of home and autoradios and record changers. Actual case histories cover practically every model made by 202 manufacturers between 1925 and 1912—Airline, Apex, Arvin, Atwater Kent, Belmont, Boach, Brunswick, Clarton, Crooley, Enceson, Fada, G.E. Kolster, Machan, Stromberg and dozens more. Gives how-to-do-idata on SPCCHE index—Non-energy dependent of the component data, service short cuts, etc.

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is, can the rumble be fixed by working on the equipment and replacing defective parts or must a higher quality turntable be obtained. Measurements of the rumble and noise content can help to answer the question. The data in Table 1 is an approximation of various rumble levels suitable for different types of installations. This may be helpful to the inexperienced.

In general, record changers have a rumble content of -10 to -35 db when measured on wide-range equipment. Turntables cover the range of -25 to -55 db. Some of the best record changers have rumble content lower than some good turntables. However the best turntables are the most quiet and dependable types of apparatus for critical installations. In setting up a new high-fidelity installation with a wide range speaker the best choice of record playing equipment is a good turntable and arm if the listener does not already have a collection of 78 records. There is really very little need for a changer if you are mainly interested in LP records. However if a record changer is desired for 78 or 45 rpm records and you are still critical of rumble there are three choices. First you can very carefully select a record changer. Some models are quite low in noise. It is a good plan to make listening tests and measurements on a few competitive models in the actual installation. A second plan is to install a dynamic noise suppressor to control rumble. The third choice is to install both a changer and a good turntable. This is often done in custom home audio systems where it is to be used by several members of the family, some preferring the changer for dance and pop music and the turntable for serious listening.

Though we have heard about rumble for many years the new advances in the audio art extending the low-frequency limit of sound equipment have highlighted this problem. Careful equipment selection and maintenance on the part of the audio amateur or service technician can do much to control rumble and increase enjoyment from home sound systems.

-30 -

#### SIMPLIFYING V.T.V.M. CALIBRATION

By KENNETH P. AURELIUS

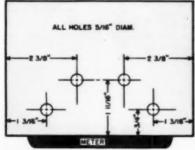
PROBABLY most people who use vacuum-tube voltmeters have, at some time or other, had occasion to recalibrate them because of jarring or aging of components. This process usually involves removal of the chassis from the cabinet.

In the "Eico" unit shown in the photograph, I drilled four holes on the top of the cabinet to obviate the need for removing the chassis. The template shown in the diagram was used to locate the holes. If other types of meters are to be so treated, you simply invert the chassis and make the necessary measurements on the top of the cabinet for the correct location of the holes.

All of the holes are 5/16 inch in diameter. Snap-button hole plugs are inserted to keep the dust out. These plugs are color coded for easy identification. With my v.t.v.m., I used the following color codes: — d.e. calibration (black); — d.e. calibration (red); a.e. zero (no color); and a.e. calibration (green).

Any long handled screwdriver or alignment tool may be used to calibrate the meter. To see the slot in the potentiometer, an adjacent snap-button plug can be removed and, by using a flashlight, the operation is easily visible.

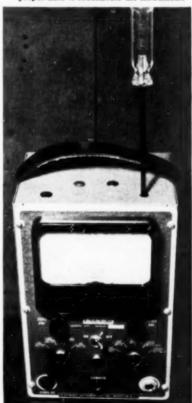
Template used to locate calibration holes in Eico Model 221 vacuum-tube voltmeter.



MARCH, 1954

The few minutes spent in drilling the cabinet pays off handsomely in time saved later on.

The color-coded holes in the v.t.v.m. cabinet. Screwdriver is inserted through the proper hole to recalibrate the instrument.





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#82 82-5/16 x 22 x 171/4	77 x 19	48.75
#10 101/2 x 211/2 x 15	834 x 19	9.70
#14 14 x 211/2 x 15	121/4 x 19	11.88
#15 15% x 211/2 x 15	14 x 19	13.20
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Size	Steel	Aluminum
136	\$ .63	\$ .73
31/2	.70	.99
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51/4	.99	1.80
834	1.25	2.15
101/2	1.48	2.70
12	1.75	3.15
14	1.99	3.63
1536	2.25	3.99
171/2	2.48	4.45
191/4	2.75	4.88
21	3.05	5.25
261/4	on request	
35	on request	
Grey	Crackle Furnished on Request-5	ame Price

CO. RADIO

#### Mac's Service Shop

(Continued from page 86)

and Webcor were planning on releasing pre-recorded tapes of classical music.

"Why does a head not in alignment hurt?'

"Suppose we want to play that photographically printed tape we were talking about," Mac said. "Let's say our playback mechanism consists of a bright light shining through a very narrow slit onto the tape and that this reflected light excites a photoelectric cell that works into our amplifier. Light falling on a white section of tape excites the cell to maximum; when it falls on a black section, the excitation is minimum. When a low frequency recording passes the slit of light, the output of the light cell swings back and forth from a maximum to a minimum at a rate that faithfully reproduces the low note.

"Suppose, though, that we try to reproduce the frequency that printed the tape with the finest distinguishable lines. If the slit through which the light shines is in precise alignment with the lines themselves, the reflected light will be turned on and cut off cleanly by the movement of the fine lines beneath the slit. On the other hand, suppose the slit is canted so that it makes an angle with the lines. Now, long before we reach a frequency at which the lines themselves run together, the slit of light will cease to fall entirely upon a single white or black line. Instead, it will fall across adjacent lines so that part of a white line and part of a black line will always be beneath the slit. That means that the reflected light can never rise to the maximum or fall to the minimum value it attained when proper head alignment allowed all the light to fall upon a single white or black line, In other words, improper head alignment results in a loss of high frequencies. Of course, if the same head is used for both recording and playback, then alignment will matter little, for the recorded lines will have to match the angle of the head, even though both are tilted from the vertical."

"How do you know when a head is in proper alignment?"

Before answering Mac opened a cabinet and took out a roll of tape on a

special 5" reel.
"This," he said, "is an alignment tape specifically prepared for head alignment by the Toogood Recording Company of Chicago. The recorded signal is .001 inch in wavelength and will reproduce at 7500 cycles-per-second at 7.5 i. p. s. or 15,000 cycles at 15 i. p. s. The signal is vertically aligned on the tape to a tolerance of 11/2 minutes of arc. While the tape has been recorded the full width, it can be used effectively on dual-track machines because great care has been taken to make sure the edges of the tape are cleanly recorded. This is



WILCOX-GAY Model 3A10 Tape Recorder

Combines all popular recording features. Two speeds, 3% and 7½" per second. Simple pushbuttons for forward, reverse, record, stop and play. Records from mike, external radio or phonograph, or other source. High speed forward and reverse. Neon recording level indicator. High quality 5x7" oval speaker. Jack for external speaker. Attractive portable case, LSM 182". With take-up reel and microphone. For 110-120 v, 60 cycles AC. Shig. W1. 26 lbs.

Wilcox-Gay 3F10 HI-FI Recorder Wilcox-Goy 3F10 Hi-Fi Recorder
Delive tape recorder with features as above,
but has push-pull amplifier to deliver 6 watte
output Resp: ±346, 75.7500 eps. at 745";
±3db, 55.10,500 eps. at 745". Two neon indicators, full range tone control, compensated
volume control, storage compartment for tape
and accessories. Size; 1835x123xx105, Shiga
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Pentron 973C. 2-Track, 2-Spd Recorder.
74F909. Shpg. wt., 27 lbs
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Newark Portable 3-Spd Record Changer
73F910. Shpg. wt., 23 lbs
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73F903. Shpg. wt , 9 lbs
RCA WV-97A. Senior Voltohmyst.
62F000. Slipg. wt., 10 lbs
Triplett 666-HH, Volt-ohm-milliammeter.
62F208. Shug. wt., 3 lbs
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Wireless Mike, With built-in midget trans-
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necessary since many half-track heads run over the edge of the tape and would give a false reading if the recording at the edges was inaccurate.

"To align the head of a home recorder, you simply play this tape at 7.5 i. p. s. and adjust the position of the head by the means provided until maximum output is indicated by an audio wattmeter inserted in the external speaker jack or by an ordinary output meter connected across the speaker voice coil. Let me say here and now, though, if you ever erase a single foot of this tape, you had better take to the hills. Furthermore, never rewind the tape or run it forward at high speed for fear of stretching it. After you are through making your alignment test, reverse the reels and let the tape wind back on this reel at playing speed."

"Is there anything else I ought to watch in working on recorders?"

"One thing comes to mind. I note some manufacturers specify carbon tet for cleaning rubber drive wheels and others say to use alcohol. Probably the cleaning agent recommended depends on the kind of rubber used, and any other cleaner may soften or damage the rubber. Always stick exactly to the cleaner recommended in the service data.

"In general, never let a recorder go out without cleaning the head thoroughly. This is something home recorder owners are likely to overlook, and it has tremendous effect on the quality of the recording. Check tape speeds with a timing tape. After this has been running for a few seconds, count the proper timing intervals that pass a certain point in exactly a minute. If the speed is off more than one full interval in this length of time, find out why. Always check all tape moving controls thoroughly, making sure they work easily, that the tape is stopped without putting excessive strain on it, and that there is no tendency to spill the tape.

"Make a short recording at an excessively high level and see if the erase head will take this off completely. If not, measure the erase voltage delivered to the head and compare this with what the service data says it should be. If that is all right, make sure the tape is held firmly against the erase head by the pressure pad. If nothing is wrong here, you are probably up against a bad head. Substituting a good head is the best test for that.

"How about checking for wow?"

"Special equipment is needed to measure wow accurately, but you can easily make a rough check by recording a frequency of about one-thousand cycles and then listening to it being played back. You are almost certain to hear some wow on home recorders, but it should not be very pronounced. You will soon learn how much to

"A rough frequency check can be made by recording a good record containing a wide range of sounds. A good piano piece constitutes a tough test. If

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cases used in secret area consequences, and in secret area classification, and in the classification of the classification of the classification of the components. From basic circuits to components: from competer, how-to-slowed the components from commercial and home built equipment to its operating and service problems, you get the latest information and expert guidance. And, chances are, you'll be amazed at the opportunities for recording specialists in this steadily expanding field.

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this sounds good on playback, the recorder response may be considered satisfactory. For a better test, record 1000, 50, 100, 500, 1000, 2500, 5000, 7500, and 10,000 cycles in that order from our audio generator, keeping the input level constant as measured with the a.c. v.t.v.m. Plug the audio wattmeter into the external speaker jack with the proper load resistor switched into use. Now, with the first 1000 cycle note being played, set the volume control so that a convenient value of output is obtained well below the maximum output rating of the amplifier. One watt should be satisfactory. Note down the reading produced on the wattmeter by each frequency. The departure of these values from the 1000-cycle reading can be converted into decibels and compared with the manufacturer's claims. Of course the tone control should be in the 'flat' position while taking the readings

"You must be expecting to do quite a bit of recorder service."

"I am. RCA predicts that schools alone will buy 50,000 tape recorders this year. More and more families are finding new uses for them around the home. I consider them easier to work on than record changers. One reason I bought this new job for the shop was so that we would have a reasonable standard of home recorder performance always at hand. On top of that, it is sometimes a great help to be able to play a recording made on a doubtful machine back on one known to be good, and vice versa. This allows you to spot whether the trouble is in the recording or playback system, or both. Now here are some good books on tape

"You've already made a bookworm out of me by loading me down with those now-here's-something-you-ought-toread things; but I'll be darned if you're going to make a tapeworm out of me!"

-30-

Training Program (Continued from page 66)

content, and then budget a fixed amount of shop time for these training efforts. It won't be perfect, and it will have bugs, but it is a first step. And, as the Chinese say, a journey of a thousand miles begins with one step. In his planning, a shop owner should overlook the fact that he may be training for a competitor or that the employee so trained may leave him. That is a separate problem. He must consider only the problem of where a dollar of training will get more than a dollar of good quality production.

The second thing for the shop owner to recognize and work at is the principle known to all good personnel men, namely, that all aspects of personnel control interlock and affect one another. It does no great good to provide good training if your policies are such that men don't like to work for Training dollars are wasted if you hire poor material to begin with. The market for technicians is not so free that there is unlimited choice in hiring, but the owner must do the best he can. Based on the material available he must set up the training that best fits his shop needs and those of his men. Then he must take a long, hard look at his general personnel policies. Here he must be competitive, not only with other service shops, but with other opportunities that his men might seek. Here are the questions that a professional personnel man asks about his company. Are my wages in line with those of other possible employers of my men? Is my vacation or sick leave policy in line? Does my sales promotion keep my men on a full time job, or do I have to lay them off during the summer? Do I have the equipment I should? Does a man working for me feel he is learning and

Allied Radio Corp. recently played host to the Chicago Acoustical and Audio Group at the association's regular dinner meeting. The 150 diners were treated to a demonstration of stereophonic sound in Allied's dining rooms. The demonstration involved the use of three of the company's "Golden Knight" 24-watt amplifiers, three Electro-Voice "Regency III" speaker systems, an Ampex special 3-channel tape recorder, and Ampex stereophonic recorded tape. The same meeting also included a lecture and demonstration on new ceramic cartridges for high-fidelity use by Howard Souther of Electro-Voice, a "black curtain test" of a series of speakers, and a binaural sound demonstration from tape.



4055 Redwood Ave., Venice, California

growing? Do my men feel that there is opportunity for advancement if they produce for me? If a company can meet the problems posed by these questions, it will not only keep its people, but can demand and get a full measure of work from them.

This is particularly true of the more seasoned men in the shop—the ones who have done some jumping around and perhaps tried a shop of their own and discovered it was no bed of roses. These are the wheel horses of any organization and the ones most costly to lose. Generally, these men place a high value upon security, and more and more companies are studying deferred compensation programs to bring stability to this important group of key men.

There is a general belief in industry that the small company cannot do the same things that the big company can do. This is a stubborn and erroneous idea. The small shop may have to do it differently, or on a more simplified scale, but basic principles apply to all working organizations regardless of size, and to be successful, management must give time to broad policy.

This problem is not an easy one. No management problem is. We cannot give a detailed blueprint here, but the broad approach outlined represents a method of attack that will bring success to the management that believes in it and is persistent in its pursuit.

The shop management that applies these techniques of manpower development need not fear that it will carry its competitors' training burden. It will be working and training for its own profit and its own public acceptance. Furthermore, it will be doing its individual share in the development of a great industry.

#### NOISE SUPPRESSION

By ROBERT A. THOMASON, W4SUD

IN THE belief that other readers of this magazine would be interested in my recent experiments on vehicular noise suppression in late model (\*49-53) Ford trucks for the Texas Gas Transmission Corporation, of which I am communications foreman, I'd like to pass on these tips.

After reducing ignition and regulator noise to a tolerable level, I found the noise still much higher than was desirable. With the help of a coaxial feed link, tied to the antenna terminals of a 50 mc. receiver, I found most of the noise was coming from the electrical oil pressure gauge (noter breek mit).

pressure gauge (meter brock unit).

Also guilty, but to a lesser degree, were the electrical temperature and gas gauges. The noise sounded like someone scratching the antenna with a knife blade. I found that by using .01 µfd, disc ceramic condensers, the noise was effectively bypassed at all three points.

These condensers should be installed with as short leads as possible. The ground side was soldered while the other lead was tightened under the screw terminal. I then tried this same technique on my 4 me, mobile station with equally good results.

W4MGT, with the Kentucky State Police, reported good results after installing a condenser on the oil gauge. —30—

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11.4	.61	BAKS	.96	604	41	6W6GT	-53	198666	1.48
11.6	.61	GALS	.43	6CB6	.81	6×4	.37	1978	.71
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185	.81	SATE	.37	8F6	.42	12ALS	.43	25L6GT	.41
155	.43	6AUS	.43	6.16	.61	12AT6	.37	25W4GT	,43
174	.61	SAVS	.37	GREGT	.38	12AT7	.71	REZECT	.36
144	.51	GAX4GT	.60	65.66	.78	12AUS	.43	3585	.48
145	.43	GRAS	.56	BLOGA	.78	12AU7	.58	3505	.48
IX2A	.65	68A7	.58	654	.41	12AV7	.73	SSLEGT	.41
394	.53	6808	.48	SSRGT	.65	12AX4GT	.60	35W4	.33
395GT	.61	6886	.46	SSATOT	.48	12AX7	.61	BEZSGT	.33
354	.48	68060	1.18	SSKTOT	.45	128A6	.46	5085	.48
344	.48	6886	.83	65L7GT	.60	120E6	.46	5005	.48
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#### Building a Multimeter

(Continued from page 71)

1000-ohm rheostat and the other to the positive test jack.

The switch legs are numbered from 1 to 11. These run counterclockwise from the pole connectors. The top deck to which the series resistors for the voltage multipliers are attached is the one nearest you when the instrument is on its face. The lower deck is immediately adjacent to the panel.

The wooden case for the meter was made from a piece of ¼" maple, 2½" wide and 30" long. Simple rabbet joints were used and the box assembled using glue and brads. The top edges were rabbeted 1/16" deep for the panel recess and the bottom edges rabbeted ¼" for the plywood back.

The two size "C" flashlight cells were secured to the back by means of a metal strap %" x 2" and a 1¼" No. 8 screw. The connections to the battery were made through two miniature Fahnestock clips soldered to the positive and negative poles. Four %" No. 4 screws were used to hold the com-

pleted meter in its case.

The reason for resistor  $R_1$ , mentioned earlier, is to facilitate the use of stock value shunts for the two current ranges and to make it an easy matter to match any 0-1 ma. meter of 100 ohms or less to this circuit.  $R_1$  is equal to the meter's internal resistance subtracted from 100 ohms. In other words, if you have a meter with an internal resistance of 55 ohms,  $R_1$  will be 45 ohms. These meters vary, depending on the manufacturer, so if you are not positive of the exact resistance

1. Install the new meter scale.

od to determine it:

Wire the circuit shown in Fig. 1B using short, heavy leads.

Place a jumper across the test jacks and carefully adjust the meter to full scale deflection.

of your meter use the following meth-

Remove the jumper and insert the 100-ohm resistor.

Read the meter resistance directly on the "Ohms" scale.

Caution: Do not attempt to measure the resistance of an instrument with an ohmmeter as the former is ex-

Fig. 2. Scale calibration for the multimeter discussed. This could be photostated and increased in size to fit either a 3 or  $4^{12}$  inch meter. The  $3^{\prime\prime\prime}$  meter scale is  $2.5/16^{\prime\prime\prime}$  wide and the  $4^{12}^{\prime\prime\prime}$  meter scale is  $3.11/16^{\prime\prime\prime}$  wide. See Editor's Note at end of article regarding the availability of a commercially drawn scale for meter.



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tremely delicate and the current flowing in the circuit is on the order of 90 to 100 ma, which would cause serious damage to the milliammeter under

The critical eye will note a built-in compromise or two, such as the fact that a 10.000-ohm resistor was used in a 1000 ohms-per-volt circuit to provide the 0-10 volt range. Actually, this value should be 9900 ohms with a 100ohm meter resistance but since the difference of 100 ohms is only 1 per-cent, it was considered a worthwhile risk since the stock 10,000 ohm value is easier to obtain than the 9900-ohm resistor

There is a slight loss of accuracy in the a.c. position but it is less than the 5 per-cent usually quoted for multimeters of this type. To correct these minor shortcomings, a complex switching system and an additional bank of resistors would be required which would result in an increase in both cost and building difficulty. The circuit, as shown was decided upon as the most practical for these reasons.

Editor's Note: For those who wish to lend a "professional" appearance to their instruments a kit, containing meter scales (for either 3" or 445" meters), front panel decals, and a builder's manual is available from Robert Hilliard Company, Box 549, Inglewood, California. The kit is \$1.00 postpaid in the U.S. When ordering specify whether the scale is to be used with a 3" or a 41/2" meter.

#### STANDOFF CONNECTOR

By OTTO WOOLLEY, WOSGG

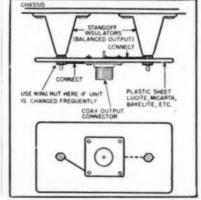
TRYING to take coaxial output from standoff insulators often results in a makeshift arrangement or mutilated cable. Using the simple adapter dia-grammed here makes a firm, solid connection that may be removed or installed

in a moment's time.

Construction of this unit is simply a matter of drilling any suitable piece of insulating material to fit the standoff centers, mounting the coax output connector, as shown, with suitable short connecting wires or ribbons.

If the unit is to be changed often, the use of wing nuts on the standoff insulators will be helpful.

A simple adapter which will provide a solid connection to standoff insulators.





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#### Stewart-Warner TV Sets

(Continued from page 62)

top of the tuner. (see Fig. 5). The output of this trap is then coupled to the individual antenna coil sections as shown in Fig. 4. The balance of operation of the v.h.f. section of this tuner will not be discussed since it is similar to a standard v.h.f. cascode-type turret tuner.

Signal output from the mixer is coupled through the converter plate i.f. coil, 458, to a coaxial socket and then fed to the receiver's i.f. amplifiers.

#### Video and Sound Stages

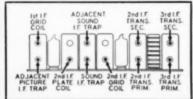
An intercarrier-type i.f. system, containing printed circuit wiring and transformers, is used in the 9340 series chassis. It is a 3-stage i.f. assembly, having a sound carrier of 41.25 mc., and a picture carrier of 45.75 mc. The first two stages are connected as cascode amplifiers, similar to those utilized in the latest type tuner circuitry, and will be discussed in their entirety in a subsequent paragraph.

The transformers, traps, and all components are mounted on a printed wiring panel, and the unit is then dip soldered to provide connection between the components. Whenever any parts have to be replaced, it is suggested that a pencil-type soldering iron be used to prevent excessive heat from destroying the printed circuit wiring. The adjustment screws for the alignment of i.f. transformers and traps are all located on one side of the strip. (See Fig. 6.)

The i.f. transformer between the tuner and the first i.f. amplifier consists of an M-derived bandpass filter. Trapping of the adjacent channel picture i.f. carrier is obtained by one section of this transformer, which highly attenuates frequencies of 39.75 mc. See Fig. 3. Between the first i.f. amplifier and the second i.f. amplifier, another M-derived bandpass filter is used. It consists of transformers 16, 25, and 22 which are mounted in three separate cans. Trapping of the sound i.f. carrier and adjacent channel sound carrier is achieved by transformer 22, which highly attenuates frequencies of 41.25 mc. and 47.75 mc.

Before proceeding further, let us examine the circuitry between the first i.f. amplifier  $(V_1)$  and the second i.f. amplifier  $(V_2)$ . Although voltage is present at the plate of  $V_1$ , there is no actual connection to "B+." Also, a.g.c.

Fig. 5. Side view of the video i.f. strip showing major alignment points.



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RADIO-ELECTRONIC ENGINEERING 366 Madison Ave., New York 17, N. Y. is present at the grid of  $V_2$ , yet the grid of  $V_1$  is the only i.f. return to the a.g.c. supply. If we examine the circuit closely, it will be noted that the cathode of  $V_z$  is connected to the plate of V1 through resistors 29 and 17 and transformer 16. Therefore, these two pentodes are connected in series across a common "B+." Since each tube contains internal resistance, we also think of these tubes as two resistors in series. Therefore, the voltage at the plate of  $V_1$  is the voltage applied to the plate of  $V_2$ , less the voltage drop across this tube, and resistors 29 and 17. In order that the potential between the grid and cathode of V2 remain within design standards, a steady state voltage is applied to the grid of  $V_z$  by the use of a voltage divider network, consisting of resistors 27 and 23.

To explain how a.g.c. voltage is applied to the grid of  $V_2$ , let us assume zero a.g.c. voltage on the grid of  $V_1$ . The current through both tubes is large at this time and the circuit is so designed that the voltage at the cathode side of resistor 26 is 130 volts. The voltage divider network maintains 130 volts at the grid of  $V_2$ . Since there is no difference in potential between the grid side of resistor 26 and the cathode side, no current will flow through this resistor; hence, no bias on the tube. When a.g.c. voltage is applied to the grid of V<sub>1</sub>, current through this tube is decreased, which produces a greater voltage drop across  $V_1$ . Therefore, the cathode side of resistor 26 has a higher potential than 130 volts. There is now a difference in potential between the grid and cathode sides of resistor 26, causing current to flow through this resistor, producing a bias on V2.

Two primary reasons are involved for this type of circuit. Under normal arrangements, the plate circuit of  $V_1$ and V2 would be returned to the 120volt supply. If this were done, the 120-volt supply would vary considerably, depending upon the area in which the receiver operates since the a.g.c. bias applied to the first two i.f. stages determines the current drain. Upon checking the circuit further, it will be noted that  $V_{18}$  (sound output tube) is connected in parallel with filter condenser, 89. Therefore, any variation in current drain of the first two i.f. tubes must pass through V15; hence, an appreciable change in the 120-volt supply, obtained from the cathode of  $V_{ii}$ , would occur when current varies. Also, this large current variation through V15 makes it difficult to design a good sound output stage. By using the cascoded type of circuit for the first two i.f. stages, both of these conditions are alleviated.

Between the second i.f. amplifier and the third i.f. amplifier, and between the third i.f. amplifier and the crystal detector (1N64), double-tuned, mutually-coupled transformers are used. The output of the third i.f. amplifier is coupled to the cathode of the crystal detector, which supplies a negative signal to the grid of the video amplifier (V,). As will be noted in







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Fig. 3, series- and parallel-peaking is used, and coil 241 is incorporated as a trap to suppress radiation of the i.f. frequencies

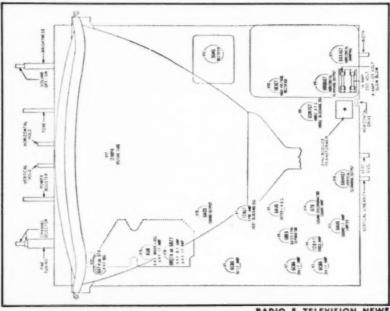
A 12BY7 (V.) is used in the video amplifier stage. The power booster control, 46, varies the bias which controls the gain of this stage. Seriesand parallel-peaking is employed in the plate circuit, and the plate load consists of resistors 54 and 55. So that the 4.5-mc. sound i.f. frequency will not be applied to the picture tube, a sound trap circuit (coil 49 and condenser 50) is connected in series with the output of  $V_4$ . Between the video amplifier and the picture tube direct coupling is used; therefore, the plate voltage of  $V_i$  is present at the cathode of the picture tube. Resistors 219 and 64 act as a voltage divider network so that the potential between the heater and cathode of the picture tube is held within its rated value. The brightness control is in the grid circuit of the picture tube, and consists of a potentiometer which varies the positive voltage applied to the grid. This positive voltage is always less than the voltage applied to the cathode. A 21MP4 picture tube is employed and is of the automatic-focusing type.

The keyed a.g.c. circuit uses a 6AU6 tube  $(V_s)$ . Upon examining the circuit, it will be seen that a positive 15,750cycle pulse is applied to the plate of  $V_{\scriptscriptstyle B}$  from the horizontal output transformer, and a portion of the positive video signal is applied to its grid. The bias on this tube is such that no conduction takes place unless both the plate and grid are driven positive at the same time. Since the pulse fed to the plate is constant, the amount of conduction will be determined solely by the positive voltage applied to the grid. The circuit is so designed that only the sync pulses of the video signal drive the grid sufficiently positive to allow current flow. Therefore, the strength of the video signal will determine the amplitude of the sync pulse which, in turn, will determine the amount of conduction that takes place in the keyer tube. Resistors 59 and 60 form the plate load, and the voltage developed across resistor 60 is filtered by condenser 58 for a.g.c.

The width of any sync pulse occupies in time about 15 per-cent of one complete video signal for one scanning line. Therefore, 85 per-cent of the noise that may be in the video signal cannot affect the a.g.c. voltage. One of the diode sections of the 6T8 ( $V_{148}$ ) is used as an a.g.c. clamper. This will prevent the a.g.c. voltage from becoming positive. Resistor 57, which is connected from the a.g.c. line to the 120volt supply, places a small positive voltage on the a.g.c. line to cancel the small residual negative voltage developed in the a.g.c. system.

The sound circuit consists of a single 4.5-mc. i.f. amplifier  $(V_{\rm D})$ , a ratio detector  $(V_{114})$ , and one audio amplifier  $(V_n)$ . These circuits are conventional with the exception of the 6AQ5  $(V_{11})$ circuit. As stated previously, this tube is connected across filter condenser 89, which means that all current supplied by the 120-volt supply must pass through  $V_{\rm B}$ . Since the tubes in the tuner, third i.f. amplifier, video amplifier, and gated sync separator stages are connected to this voltage source. the current to these stages will vary in different areas of operation. This variation is small enough to be of advantage. The positive voltage applied to the grid of  $V_{13}$  is held constant by the use of a voltage divider consisting of resistors 177 and 178. Therefore, the cathode voltage will determine the bias on this tube. If the receiver is operated in a fringe area, the current

Fig. 7. Top view of the Stewart-Warner 9340 series TV chassis showing tube layout.



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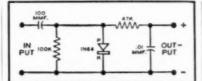


Fig. 8. The detector network used with v.t.v.m. for step 8 in alignment table if h.t. meter probe is not available.

through the 6AQ5 increases, resulting in a lower cathode voltage. The bias is then automatically decreased, increasing the gain of the tube. When the set is operated in a strong signal area, the reverse occurs. Therefore, in strong signal areas, the gain of this stage is minimum and in weak signal areas maximum, yet within design standards for minimum sound distor-

#### Sync Stages

The composite video outputs of both the video detector and video amplifier are applied to the gated sync separator stage  $(V_c)$ . The tube used is a 6BE6 heptode and, in addition to sync separation, it acts as a noise canceller. If we momentarily assume that the first grid (pin 1) is removed, this tube will act as a normal sync separator. Operation of this type of circuit is poor in the presence of noise bursts which are in excess of the sync pulse, as the noise will cause a larger amount of grid current to be drawn. This results in a bias increase bringing about a decreased sync pulse level and, in some instances, a complete loss of sync output. Also, the output still contains the noise pulse which will trigger the sweep oscillator circuits at the random rate of this noise. Both of these limitations bring about poor holding ac-

In the gated system used, a composite negative signal is applied to the first grid (pin 1) at the same time the composite positive signal is applied to the second grid (pin 7). Except for polarity and amplitude, both of these signals are identical in shape. signal applied to the second grid is always larger in amplitude, resulting in a negative sync output. The first grid is biased so that the tube will cut off whenever its voltage becomes slightly more negative than the sync pulse amplitude. Therefore, whenever a noise pulse whose amplitude is in excess of the sync pulse reaches the first grid. the tube cuts off. It then becomes impossible for the second grid to draw current due to the noise, as well as preventing noise pulses in excess of the sync pulse appearing in the output. If, by chance, the noise is riding on the sync pulse, this circuit will eliminate the noise as well as the sync pulse. Fortunately, this will not occur very often, so that the flywheel action of the horizontal oscillator circuit keeps the oscillator in sync for several periods. From the output of this stage, the sync signal is coupled to the sync amplifier  $(V_{:1})$ , which merely amplifies

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the sync pulse and inverts its polarity for proper use with the horizontal and vertical oscillator stages.

The horizontal oscillator and associated frequency control system consists of a blocking oscillator and pulsewidth type a.f.c. circuit. A 6SN7GT tube is used for this purpose. Tube  $V_{sA}$  acts as the frequency control section, comparing the horizontal oscillator frequency with that of the incoming sync pulses. The comparison frequency originates from two sources, the output of the horizontal oscillator itself, and a portion of the horizontal output from a tap on the flyback transformer. The position of the feedback pulse on the sync determines the current drain in this section of the tube. Since resistor 117 in the cathode of  $V_{34}$  is also common to the grid of the blocking oscillator  $(V_{s\theta})$ , a change in current drain in  $V_{s4}$ , produced by a change in frequency of the feedback pulse, will be felt as a voltage change on the grid of  $V_{sB}$ , altering its frequen-The horizontal hold control, 123, varies the plate voltage of  $V_{\rm M}$ , which changes the current through the tube; hence, altering the voltage across resistor 117.

The saw-tooth output of the horizontal oscillator is coupled to the horizontal output stage which utilizes a 6BQ6GT tube (Va). A flyback transformer of the auto-transformer type is connected to the output of  $V_{\bullet}$ Through this transformer, in association with the deflection yoke, high voltage is developed as well as boost voltage. Horizontal damping is provided by a 6AX4GT tube  $(V_{ii})$ , and the width control is located in the plate circuit of this tube. In series with the plate circuit of this tube is the quarter-amp fuse. Horizontal retrace blanking is provided by reshaping a portion of the horizontal output and connecting it to the grid of the picture tube.

The low-voltage power supply in this chassis utilizes a 5U4G tube  $(V_{12})$  which is operated as a full-wave rectifier and the output is separated into four distinct voltage sources. The primary of the power transformer contains a 4-amp slow-blow fuse. The heaters of those tubes, whose cathodes contain a higher-than-normal voltage potential, are returned to the 120-volt supply through isolating resistor 83. This will avoid the possibility of a cathode-to-heater short due to a large potential difference.

Before proceeding to the alignment of this receiver as outlined in Table 1, be sure to do the following:

 Insulate the oscillator contacts on the tuner strip to render the oscillator inoperative. Use cellulose tape on the first two contacts from the front of the drum assembly.

Short the antenna terminals together with a jumper wire.

Keep the marker generator output at a level that provides a readable marker but does not distort the curve on the scope.

4. Proceed to step 1, Table 1. -30-



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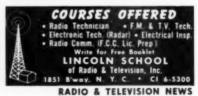
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#### Trends in AM Receivers

(Continued from page 51)

In essence, the printed wiring replaces the hookup wire formerly employed to connect the various portions of the circuit together. In these receivers, the printed wiring is permanently fixed to the plastic chassis base by a photoengraving process. See Fig. 1. Normal components, such as resistors, condensers, and coils are then soldered into position. For tubes, appropriate holes are drilled into the panel and then clips are inserted in these holes. The tube pins fit into these clips and thereby make electrical contact with the rest of the circuit.

There are several different methods of fabricating these printed wires. Motorola, for example, places the printed wires on both sides of the plastic base and components are mounted on each The metal printing extends through holes on the chassis, connecting circuits on the front with those on the rear. Admiral, on the other hand, places all of its wiring on one side and all the components on the other side. This permits them to do away with hand soldered connections. After the components (with the exception of the tubes) have been mounted and their wires pulled through holes in the chassis to appropriate points on the printed wiring side, the underside is dipped into a large solder "bath" or pot. This secures the component leads to the printed wiring. The excess sol-der is then brushed of (literally) and any excess lead length clipped.

Troubleshooting and parts replacement will in general be the same as for receivers wired with hookup wire. However, there are certain precautions to observe when parts must be replaced. These are as follows:

1. Do not use too large a soldering iron when changing parts. 60 watts or less is recommended. Do not use a soldering gun.

2. To remove a defective component, apply the tip of the soldering iron to the point of connection. Keep the soldering iron on the connection just long enough to melt the solder, then quickly tap the chassis against the service bench to shake the solder away from the connection. After the solder is removed, untwist or separate connections. A pick will be helpful for this. After disconnecting wires or lugs, carefully remove components from the top side of the chassis.

Motorola recommends that i.f. transformers, the tuning condenser, volume control, oscillator coil, or the electrolytic condenser be removed by immersing all the lugs simultaneously into a small soldering pot. The component may then be lifted off the chassis easily. Motorola feels that the soldering pot is superior to the soldering iron because, with the latter, plated connections may be pulled loose from the chassis.

3. To prevent tube breakage, remove



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them before any parts are replaced. Also, when a tube is pulled out, pull it straight out. Wiggling the tube from side to side, a customary procedure in other sets, may cause a tube clip to bend and lead to subsequent poor contact.

4. Before installing replacement components, clean the solder from the connection point so that the leads or lugs can be pushed through the holes in the chassis panel. To avoid running solder into adjacent leads of the printed circuit, use as little solder as possible.

Resistors and condensers may be replaced quickly by clipping out the defective part and soldering the new part to the connecting leads remaining from the original part.

An open or damaged section of printed circuit wiring can be replaced by soldering a jumper of ordinary hookup wire across the connection points. To eliminate the need for complete tube socket replacement, defective tube socket pin clips may be replaced individually.

The chassis of most printed-wire receivers are connected directly to one side of the power line. To avoid possibility of damage to test equipment or to printed circuit wiring, do not place the chassis directly on a metal service bench, tools, or other metal objects.

When taking voltage readings or making resistance measurements, use test leads with needle point prods to avoid possibility of short circuits between sections of the printed circuit wiring. -30-

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#### ERRATUM

Several readers have writen us that they are finding it difficult to obtain the Stanwyck LHO-2 ccil specified in the parts list accompanying the "Theremin" article in the January issue. This number is a manulacturer's part number. Its replacement number is the Stanwyck 3582 ringing coil and it is under this number that you will find it at your parts distributors. The Stanwyck 57416 may clao be used in this application. If the 3582 is used change the i.d. of L.-L. from "1/16" to 1/71." c hange the resistance of L. from 30 to 20 ohm.

Condenser  $C_{11}$  in the schematic diagram accompanying "Foolproof 2-Band Transmitter" (page 116, December 1953) should have a value of .001  $_{\rm fl}$ dd., 600 volts. The value was omitted from the parts list.



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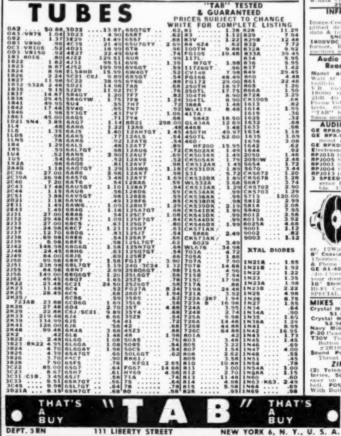
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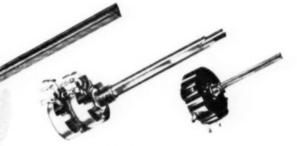


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